DINOSPHERE: A DAY IN THE LIFE

A CREATIVE PROJECT

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# CHAPTER ONE: INTRODUCTION

According to child development and neuroscience research, children learn actively. They need to be able to move, use their senses, get their hands on things, interact with other kids and teachers, and use their imaginations. However, kids are often expected to learn through rigorous instruction. Play is disappearing from classrooms to make room for more academic instruction (Strauss, 2015). Instead of active, hands-on learning, children now have to sit in chairs for long periods of time learning through strict, standardized lesson plans. Testing and assessment have become a primary focus in K-5 classrooms; yet it is proven that the most important competencies necessary for academic success among young children can't be tested (Strauss, 2015). Among these competencies are self-regulation, problem solving, social and emotional competence, imagination, initiative, curiosity, and original thinking, concepts that can't be reduced to numbers (Strauss, 2015).

Expecting young children to know facts or skills at specified ages is not compatible with how they learn. It emphasizes right and wrong answers instead of the developmental progressions that exemplify learning. Furthermore, fixation on standardized testing has caused immeasurable harm by putting testing above teaching and learning (Weingarten & Carlsson-Paige, 2013). However, money, time, and resources are dedicated to impel teachers to implement required assessments. We often hear about the importance of preparing children for society and life as productive adults, but it means nothing unless we take the steps to actually do it. That begins with appropriate early learning grounded in the research and theory of child development (Weingarten and Carlsson-Paige, 2013).

Although learning in schools includes elements that are developmentally flawed, museums remain a place where personal learning occurs. Almost all museums have a common interest in providing enjoyable, public, free-choice learning opportunities through different types of educational media, such as exhibitions, programs, and presentations combined with print, broadcast, and online media (Falk & Dierking, 2000). In the 1970s there was confusion about the distinction between formal and informal learning settings (Falk & Dierking, 1992). Formal learning settings are usually classroom-based with a trained teacher incorporating educational standards, while informal learning settings typically happen outside the classroom and are more flexible with the content. Classrooms are considered formal and museums are considered informal (Falk & Dierking, 1992). Although constructivist ideas of learning have been circulating in classrooms, museums still thrive on behaviorist learning; observable events have an impact on the development of behavior (Berk, 2000). But from the constructivist perspective, learning in and from museums is not just about what the museums want visitors to learn. It is just as much about the meaning visitors make from the museum experience (Falk, Dierking & Adams, 2011).

The future of museums will have to accommodate evolving ideas about learning, as well as the quickly-changing world. Today's museum visitors bring more expectations about digital experiences. Thus, development of the next generation of museum technologies is a challenge. These technologies often tailor content to specific visitor demographics and improve visitor engagement by providing experiences that better fit a particular demographic group. Interactive technologies are often intended to establish relationships between products, people, and physical contexts (Gottlieb, 2008). However, they must be implemented in new ways that engage and stimulate contemporary audiences (Gottlieb, 2008). In order to meet these expectations, technologies in and about museums must provide seamless, holistically designed learning experiences that are appealing to visitors before, during, and after a museum visit (Falk & Dierking, 2008). The combination of physical and digital spaces in museums offers novel ways to engage visitors through tangible interaction. To address these concerns, this project is guided by two main questions: 1) How is technology best used in museums to promote learning? 2) How might digital and physical spaces work together in museum exhibits to create a successful learning environment?

To explore these questions in novel ways, a partnership was forged with The Children's Museum of Indianapolis, the world's largest children's museum, receiving more than one million visitors annually. The official mission of the museum is "...to create extraordinary learning experiences across the arts, sciences and humanities that have the power to transform the lives of children and families” (The Children’s Museum of Indianapolis). According to the Children’s Museum's website, the first of four core values of the museum is promoting family learning. There are four specific ways in which the museum aims to do so: 1) by creating transformational family learning experiences across sciences, arts, and humanities that promote engagement through the use of real objects, immersive environments, and live interpretation; 2) by meeting the learning needs and interests of children and families to nurture hands-on, minds-on experiences; 3) by supporting educational opportunities for children aged pre-K through 16 years old by serving as a valued resource for schools, teachers, and teacher training institutions; and 4) by developing and leveraging the museum’s brand to retain and grow new audiences and connect and nurture all visitors beyond the museum visit. As a result, most exhibits are designed to be interactive, allowing children and families to actively participate.

According to members of the exhibit development team, one of the challenges the Children’s Museum of Indianapolis faces is measuring and improving learning experiences within exhibits. One such exhibit, *Dinosphere*, transports visitors back more than 65 million years to the land of dinosaurs. This exhibit features a sound and light experience that simulates a day in the late Cretaceous period. The center of the exhibit includes three themed fossil scenes: *T. rex Attack*, *The Watering Hole, and Scavenger vs Predator.* The exhibit allows visitors to perform fossil excavations in the *Dig Site*, view and touch real dinosaur fossils – including a real *T. rex* fossil – in the *Paleo Prep Lab*, talk with real paleontologists, and interact with games and touch-screen learning activities. Although *Dinosphere* is one of the most popular exhibits at the museum, preliminary ethnographic research conducted by master’s students enrolled in a usability and user experience research methods class found that children engaged with the digital spaces of the exhibit much less than the physical experiences. Generally speaking, visitors were intrigued by the physical spaces and the *Dinosphere* exhibit does an exceptional job of displaying artifacts in a way that draws attention and creates a learning experience.

However, the digital spaces were not as effective and meaningful to visitors as spaces that physically engaged them. According to preliminary ethnographic research, *Dinosphere* visitors did not connect on a personal level with the digital spaces, which caused them to be disinterested. Thus, an opportunity exists to improve the digital *Dinosphere* experience so that it is both engaging on its own and integrates more effectively with physical experiences. This paper chronicles the development of a prototype for an interactive learning experience that consists of three stations that each include a physical and digital component. The layout of the current *Dinosphere* exhibit is displayed in Figure 1. Figure 2 highlights the spaces of the exhibit that are reflected in this project.

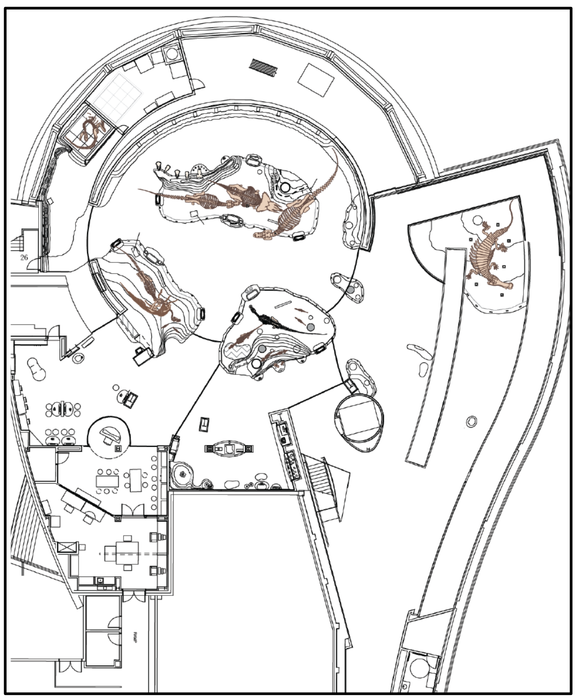

**Figure 1. Current *Dinosphere* layout.**

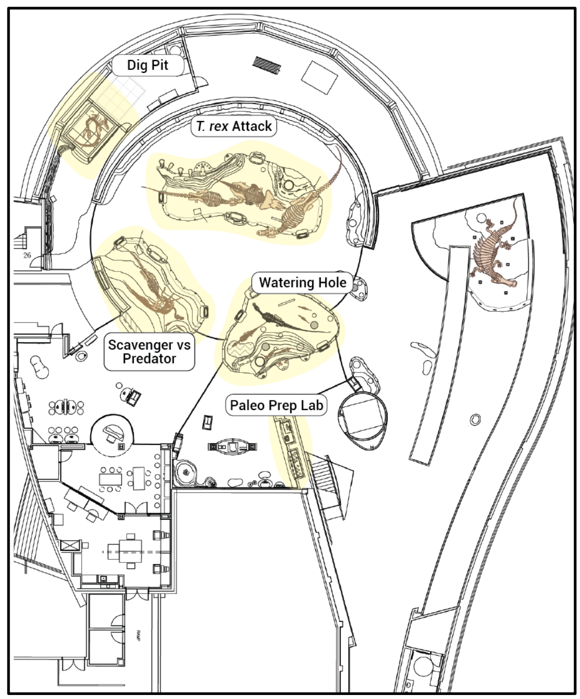


**Figure 2. Spaces in this interactive experience**

This interactive experience is called "*Dinosphere:* A Day in the Life." Museum visitors role play as a paleontologist for the duration of their visit in the *Dinosphere* exhibit at the Children's Museum of Indianapolis. Visitors may or may not choose to interact with this experience; and if they choose not to, they may still visit the *Dinosphere* exhibit as they normally would. Those that do choose to interact with this experience will receive a paleontologist lab coat, a name tag and an iPad, which represents their paleo notebook. The paleo notebook consists of a paleo profile the visitor creates with their name and picture and three digital activities that correspond with five physical spaces in the exhibit. Visitors complete each activity and earn three different types of badges: dig badges, fossil badges, and curiosity badges. By earning badges, visitors' paleo status increases. Becoming an expert paleontologist is the overall goal of the experience, which is earned by completing all three activities. This experience is designed to create a more engaging digital experience, to generate more of a connection between physical and digital spaces and to enhance the overall experience of the *Dinosphere* exhibit. It should be noted that another Master's Degree student in the Center for Emerging Media Design & Development at Ball State University developed a thesis project focused on a comparative study of usability and user experience of the *Dinosphere* exhibit at the Children's Museum of Indianapolis before and after the implementation of this creative project. The thesis project is titled "*Dinosphere*: A Day in the Life - Usability and User Experience Research for Meaningful Play" (Kitchel, forthcoming).

## CHAPTER TWO: LITERATURE REVIEW

This literature review focuses on three main areas of research: the museum experience and museum visitors, learning in museums, and cross-platform spaces in museums.

### The museum experience and museum visitors

Today's museums are much different than the collection-driven museums of the past. This culture shift has begun to focus on communication with visitors (Chang, 2006). Modern museums are looking for a combination of education and entertainment to create an experience that engages the visitor in free-choice learning (Falk & Dierking, 2008). The museum experience consists of a person's thoughts before visiting a museum, what occurs through the actual visit and then after the visit, when the museum experience is just a memory (Henry, 2000). In order to construct a learning experience that lasts throughout and beyond the museum, modern museums are placing the learner at the center of activity, interacting with appropriate digital technologies (Rudman, 2008). Visitor research is an important area for audience development professionals who want to understand visitors. Collecting demographic and ethnographic data, as well as pre and post museum visit data can help develop general models of museum visitorship. This research can be very beneficial to exhibit development teams, resulting in the production of exhibits that meet specific wants and needs of museum visitors.

#### *Understanding the visitor: Falk's visitor experience model*

Museum researcher John H. Falk suggests that most visitors will arrive to a museum with a prevalent identity-related motivation for the visit. The museum visitor experience is not distinct and is a relationship that uniquely occurs each time a visitor interacts with a museum. To describe that relationship, Falk developed a model of five visitor self-identities: explorer, facilitator, experience seeker, professional/hobbyist, and recharger. In this model, each of the categories represents a significant museum visitors view and what identity-related needs the museum best supports. A majority of the visitor types have a clear motivation when visiting a museum, however they may represent different visitor types depending on the type of museum they are visiting and their motivations for doing so (Falk, 2009).

Explorers are attracted to the museum because they are curious or have interest in an exhibit or specific content being displayed that appeals to their interests. They value learning and are eager to learn more about museum content in a general way (Falk, 2009). Facilitators visit museums to satisfy the needs of someone they care about, rather than just themselves. There are two groups of facilitators: facilitating parents and facilitating socializers. Facilitating parents are usually parents or grandparents who want to accommodate the interests of their children or grandchildren. Facilitating socializers are adults visiting the museum to satisfy the interests of another adult, such as a spouse, boyfriend/girlfriend, or friend. The identity-related goal of a facilitator is not to be a knowledge-seeker but to be looked at as a good parent or social companion (Falk, 2009). Experience-seekers are visitors who attend primarily for the experience. Although learning isn't the priority of their visit, an experience-seeker understands and values the learning setting of a museum. The primary goal of their visit is to see whatever is iconic or important on display or something that will attract their attention (Falk, 2009). Professional/hobbyists come to the museum with a completely different outlook than the typical visitor. Professional/hobbyists attend a museum on a mission, relying on prior knowledge and interest to focus on an item or subject they want to study. Professional/hobbyists also have very specific goals and specific plans about how to achieve them (Falk, 2009). Rechargers seek rejuvenation in museums because they represent places that give them the opportunity to avoid the irritations of the outside world. Rechargers want to be removed from their everyday environments and, therefore, may be less interested in the actual content than the relaxing experience (Falk, 2009).

This model emphasizes the overall goal for museums: to help visitors reinforce their identity-related motivations (Falk, 2009). Iterative tests, interviews, and surveys indicated that almost all visitors entered a museum with a single, dominant motivation (Falk, 2009). There was also a strong relationship between identity-related motivation and what visitors actually learned at the museum (Falk, 2009). The identity-related museum motivations concept provides an understanding of how to best accommodate museum visitors' needs and how to improve the overall museum experience: enhancing current visitors' experiences, improving the regularity of current visitors and providing new ways to attract new visitors (Falk, 2009).

Learning is something that has remained constant over time. However, what people learn and the understanding of how and why people learn has changed (Falk, Dierking & Adams, 2011). People are learning all the time; there is not just one correct way to learn, and no specific place or time in which people learn. Learning happens continuously and as a community of learners, people must understand what is important to learn. There are three main places in society where we find this understanding - school and universities, the workplace and the free-choice learning area (Falk & Dierking, 2002). All three are fundamental for lifelong learning. The need for free-choice learning can be fulfilled in museums, allowing people to tap into a broad array of resources (Falk & Dierking, 2002). Learning in and from museums is just as much about what meaning the visitor chooses to make of the experience as it is about what the museum hopes to teach the visitor (Falk, Dierking & Adams, 2011).

**Learning in Museums**

It is evident that people learn in museums, but it is very difficult to prove this statement (Falk & Dierking, 2011). Museum visitors absorb events and observations mentally based on personal significance, determined by events in their lives before and after the museum visit (Falk & Dierking, 1992). Not all experiences in a museum are absorbed by the visitor, but those that are can be considered learning (Falk & Dierking, 1992). Museum learning is a difficult interactive experience and there are two methods that determine why people remember certain things but not others; previous knowledge and subsequent experience. Previous knowledge assumes that memories were previously established and reinforcement at the museum allows the memory to be retained and repetition is a crucial method for retaining long-term memories (Falk & Dierking, 1992). Research by E.F. Loftus and J.C. Palmer states, "Two kinds of information go into one's memory for some complex occurrence. The first is information gleaned during the perception of the original event; the second is external information supplied after the fact. Over time these two sources may be integrated in such a way that we are unable to tell from which source some specific detail is recalled. All we have is 'one memory'" (Falk & Dierking, 1992, 124). A better understanding of what and how museum visitors learn make it easier to improve the overall quality of a museum visit. The framework of the Contextual Model of learning helps guide us to where and how to look for learning from museums by providing understanding of the factors that have an impact on such learning (Falk & Dierking, 2000).

*Falk's Contextual Model of Learning*

Once visitors are in the museum, exhibitors must consider how to engage them. Derived from observations of real people in real settings, Falk proposed the Contextual Model of Learning to further explain the learning process in the context of a museum. This model promotes understanding and organization of the complexity and authenticity of the learning process (Falk & Dierking, 2000).

The Contextual Model of Learning is a framework with three overlapping contexts that affect what and how people learn from different experiences: personal context, sociocultural context, and physical context (Falk, 2009). Learning is the process and product of the interactions between all three of these contexts (Falk & Dierking, 2000). Personal context refers to the notion that learning is a personal experience that requires motivation. This motivation comes from an individual's perception of a supporting environment, engagement in meaningful activities, having choice and control and challenges that are appropriate to one's skill (Falk & Dierking 2000). Learning is also facilitated by personal interest, constructed by prior experience and knowledge and expressed with appropriate contexts (Falk & Dierking 2000). Sociocultural context refers to the notion that learning is both an individual and group experience. Psychologists have proposed that all learning happens within a "community of learners" defined by the boundaries of shared knowledge and experience (Falk & Dierking, 2000). At museums, visitors engage with each other as well as the exhibit artifacts and media, which provides a form of social interaction between the content creators and the audience (Falk & Dierking, 2000). Finally, physical context refers to the notion that all learning is cooperatively related to the environment in which it occurs and is dependent on an individual's ability to remember prior experiences within the context of a physical setting. What people see and do at a museum helps them make sense of their overall museum experience. Visitors form memories of events without purposely memorizing them and are likely to remember their experience by talking about what they did and saw (Falk & Dierking, 2000). The physical context of the museum plays a great role in learning as well.

The Contextual Model of Learning provides an understanding of how visitors learn in museums and the factors that allow for these learning experiences. The personal context suggests that personalization, prior knowledge and experiences, and choice and control help visitors direct their learning (Falk & Storksdieck 2005). The sociocultural context suggests that learning is supported when it involves social engagement (Falk & Storksdieck 2005). The physical context suggests that the museum environment is important to visitor learning. Visitors should be familiarized to museum content in order to expose them to exhibits and programs before, during and after the visit (Falk & Storksdieck 2005).

*Free-choice learning*

Free-choice learning is the most common and dominant type of learning. This type of learning is influenced by personal wants and needs of an individual and usually happens outside of the structured areas of a school or classroom (Falk & Dierking, 2002). People are more likely to be motivated to learn when there is an anticipated beneficial outcome. Researchers have found that humans are motivated to learn when they are in supporting environments, engaged in meaningful activities, freed from anxiety, fear and other negative mental states, have choice and control and the challenges of the task meet their skills (Falk & Dierking, 2002). Although this concept is done out of a desire for personal self-satisfaction and relaxation, it is still learning.

Museums are places where leisure and learning intersect. Visitors can engage in free-choice learning on a more personal level, constructing knowledge by making connections between their lives and the objects they encounter in museums (Mayer, 2005). According to tourism researcher Jan Packer, most people visit museums to "experience learning for fun." They enjoy the process of learning that the museum offers; compared to the school-based idea of an end-product (Falk, 2009). From this research, five concepts related to learning in a museum setting emerged: 1) Learning for fun involves a mixture of discovery, exploration, mental stimulation and excitement; 2) The majority of people consider learning to be, more than anything, enjoyable; 3) Although most visitors don't visit with any intentions to learn, they do look for or are unconsciously drawn into experiences that integrate learning; 4) Visitors identify four conditions that together are beneficial to the experience of learning for fun: a sense of discovery, appeal to multiple senses, the impression of effortlessness, and the availability of choice; and 5) Visitors value learning for fun because it is an experience that has the potential to transform.

The idea of a free-choice learning environment is different from a typical school environment because expectation and judgement of progress is very minimal and natural identity-related motivations dominate (Falk, 2009). Educators strive to create pleasurable learning experiences that makes children feel comfortable and keep them engaged. One way to maintain this objective is through play -- supporting children's development and connecting them to important components of their everyday lives (Krakowski, 2012).

*Guided play*

Play is the primary engine of human-growth; it is universal. It is the way children build ideas, make sense of their experiences, and feel safe. Research in child development and neuroscience proves that young children learn actively. They have to move, use their senses, get their hands on things, interact with other kids and teachers, create, and invent (Strauss, 2015). Researchers agree that the distinct characteristics of play include: active engagement, intrinsic motivation, attention to process rather than the ends, nonliteral behavior and freedom from external rules (Krakowski, 2012).

Guided play is an avenue through which parents and educators provide a playful, child-centered approach to learning. It has many of the same characteristics of free play, however it is teacher-directed and is intentional for education purposes (Krakowski, 2012). When children play, they develop critical cognitive, emotional, social, and physical skills and are able to distinguish their own needs and find activities that relate to their learning styles. Free play leaves the field too open and doesn't help children focus on the target outcomes and academic instruction helps them memorize but doesn't transfer what they've learned (Hirsh-Pasek & Golinkoff, 2004). Guided play keeps children engaged and allows them to direct the learning with active participation (Weisburg, Hirsh-Pasek & Golinkoff, 2013). Guided play is considered beneficial because it naturally encourages children to focus on the dimensions of importance of the learning goal. Psychologist Jean Piaget asserted that play is a serious business for children and is crucial in achieving a healthy adulthood. He noted that it is a form of mental gymnastics that helps educate and exercise the developing mind and prepares an individual for the challenges of life (Piaget, 1952).

Children need opportunities to engage in both play and academic skill building because they learn best when they are active and engaged, both of which happen when they play (Simpson, 2016). The characteristics we want children to develop – self-regulation, problem solving, social and emotional competence, imagination, initiative, curiosity, original thinking – make or break success in school and life and can't be reduced to numbers (Strauss, 2015). By way of example, the Conversation on Early Learning event hosted in partnership with Boston Children's Museum in the fall of 2015, explored the power of multidisciplinary collaboration, leveraging the expertise of panelists and attendees to generate creative thinking and dialogue around concepts like playful learning, the science of learning, and the community's role in caring for young children. Local community locations were transformed into learning environments for children and their families, promoting play that involves hands-on learning (Simpson, 2016). Guided play is an effective approach for young children that can happen almost anywhere.

*Guided play in museums*

Play is an essential, effective strategy for engaging young children in museums. Children can pretend to be a person in another place and time related to the exhibits. When it comes to children's museums, different kinds of play occur, including pretend play, media play and physical play (White, 2013). Pretend play encourages creative problem solving, allowing children to practice language use and can improve function skills. Media play gives children to use interactive technology, promoting playful learning and the opportunity to practice a variety of skills. Physical play encourages children to engage in physical activity in a playful context, boosting a healthy lifestyle and better academic performance.

By way of example, in the spring of 2010, a Falk Laboratory School kindergarten class took a trip to the Warhol Museum in which children's play was the focal point of the museum experience. Museum educators visited the classroom before the trip with an interactive presentation about Andy Warhol, making connections to everyday experiences. The children learned they would be creating silkscreened capes in the museum's art studio. The day of the trip the children were involved in activities that each contained surprises. Each activity used a playful approach to engage them with a work of art. The children remained engaged for three hours and continued to wear their capes. A year after the trip, the children were asked to bring their capes to school and reflect on the museum visit. Collectively, they shared detailed memories about the hands-on activities and their capes (Krakowski, 2012).

The form and direction used in play at museums is unique to the contexts, the educators' experience, the museum collections and the age and interest of the visitors. Children should be engaged in pleasurable learning experiences while also feeling safe and comfortable. Play supports their intellectual, emotional and social development and can connect them to what is important and relevant in their everyday lives (Krakowski, 2012). This can take place in physical, digital and interactive spaces within a museum exhibit.

**Learning in cross-media spaces in museums**

The physical context of the museum can either enhance or derail the learning experience. The physical environment is linked to ways in which people learn through cognitive fatigue, distraction, motivation, emotional affect, and anxiety, each affecting how adults and children learn in museum settings (Maxwell & Evans, 2002).

Museum visitors become actively involved in their immediate environments. It is generally assumed that objects and labels have the greatest influence on the visitor's museum experience. Research proposes that not all museum exhibits operate as simply and efficiently as exhibit designers wish they would (Falk & Dierking, 1992). Visitors are often overwhelmed with the amount of activity going on in a museum setting and tend to be discriminating between and within exhibits. When visitors choose to stop and stay at an exhibit to read, discuss and interact, it is called "holding power," when they engage with the exhibit it is called "teaching power." Visitors will choose to discuss and engage with what is most visually and intellectually interesting to them (Falk & Dierking, 1992). Most museum visitors deal with exhibits on a concrete level. Museums are uniquely designed to take advantage of this situation for humans to learn by consuming concrete information (Falk & Dierking, 1992). However, museum exhibits are often designed to convey abstract concepts. Museum visitors read labels to confirm their own conceptual framework or to determine the correct conceptual framework if their own is insufficient. Research has shown that museum visitors spend an average of ten seconds or less reading exhibit labels and most label reading happens within the first 20 to 30 minutes of the visit (Falk & Dierking, 1992). Although exhibits and labels are important to the museum experience, there are many other factors that determine the effectiveness of transferring information to museum visitors. The visitor's perspective of the museum is a holistic view, including all parts; this is called the "museum gestalt" (Falk & Dierking, 1992). Museums also "tell stories" through collection, informed selection, and meaningful display of artifacts and the use of exploratory visual and narrative design in the exhibit spaces. Authenticity is something both exhibit creators and museum visitors strive to achieve in museum experiences (Roussou 2010). Digital technology provides a variety of resources through a wide range of animations, video, static images, sound, and text. It enriches the visitors' enjoyment and connects them with other learners, providing opportunities to explore and create models of real-world systems. Digital technology also allows visitors to engage in gameplay and exploration of experiences. For example, the computer interactive at the "Energy-Fuelling the Future" exhibit at the Science Museum in London allows visitors to play the role of a minister of energy for an imaginary country. Visitors are able to determine the energy policy over a twenty-five year period and then see how their decision impacted the country's economy, environment and political careers (Gammon & Burch, 2008). This experience allows the visitor to role-play in addition to interacting with the physical and digital components of the exhibit.

*Human-computer-context-interaction*

Interface and content play a significant role in effectively increasing participation from museum visitors. Described by Yao-Ting Sung, the human-computer-context interaction (HCCI) framework is used to design mobile guidebooks to enhance interaction and stimulate motivation. There are two features to this framework; the design and application of the tool should incorporate the context within a museum learning environment (visitors, their companions, exhibits, and cultural/social meanings surrounding exhibits) and the tool should facilitate a visitor's interaction with all aspects previously mentioned (Sung, 2010). According to the HCCI framework shown in Figure 3**,** the interactivity that mobile digital tools offer museum visitors happens across four levels: visitor-computer interaction, visitor-computer-object interaction, visitor-computer-context interaction, and peer-computer-context interaction.

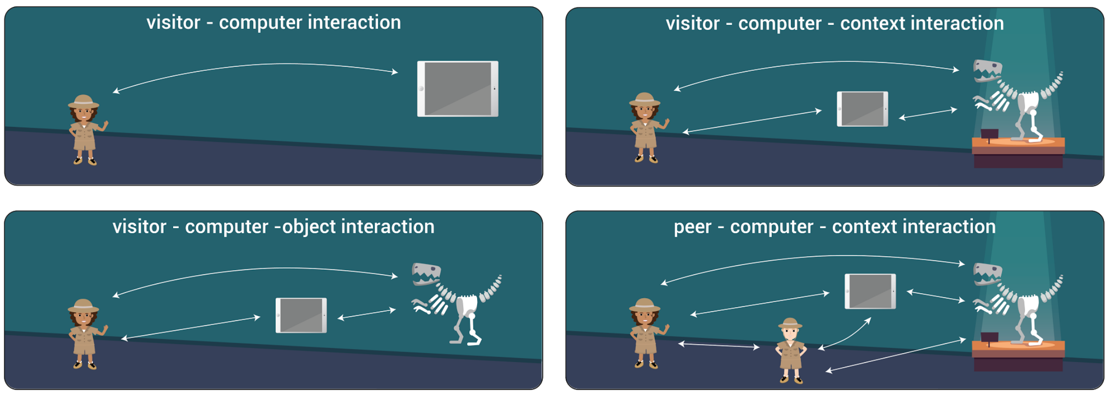


**Figure 3. Framework of the human-computer-context-interaction for designing mobile guidebooks**

*Visitor-computer interaction* refers to the idea that visitors must engage with interfaces in order to use mobile tools. This represents the most basic level of interaction that limits potential if it is the only function the device provides (Sung 2010, 75). *Visitor-computer-object interaction* refers to the notion that mobile tools allow visitors to interact with digital tools in addition to the real exhibit content of the museum (Sung 2010, 75). Therefore, mobile tools can mediate interaction with museum content by drawing attention to specific objects or providing additional information. *Visitor-computer-context interaction* refers to the idea that not only do mobile tools engage visitors with physical museum content, but they can also engage interaction between visitors and the context of the exhibit. This type of interaction connects with the visitors' prior knowledge and promotes a more meaningful understanding of the exhibit (Sung 2010, 75). Finally*, peer-computer-context interaction* relates to the idea that mobile tools encourage peer-to-peer interaction and avoid isolating an individual. This type of interaction facilitates interaction between visitors based on common interests in the exhibits and their relevant context (Sung 2010, 75).

A significant example of this framework is the Cooper Hewitt Museum of Design's Pen. It is used to encourage visitors to engage with what is on display at the museum. The Pen can be used to digitally save and collect objects, draw on interactive tables and even create personal designs. This generates more of a social space for the museum. Following the museum visit, visitors can connect with their retrieved objects online using a specific URL printed on their ticket. The Pen gives visitors a unique way of utilizing their creativity while deepening their engagement with what is on display at the museum (Dale, 2016).

*Cross-platform museum exhibits*

One challenge for museums is incorporating technologies at the intersection of the digital realm and the physical space of the museum. The role of digital interactives provides an opportunity to explore the digital/physical threshold of technology's role and influence within a given institution (French, 2016). Interactive exhibits allow for interaction in some form other than mere visual perception. This usually involves physical manipulation, such as clicking buttons or flicking switches. The general goal of interactive exhibits is to allow for learning and entertainment (Haywood & Cairns, 2006). Interactivity has become important in museums and the success of digital technologies in the workplace, home and public arena has encouraged museum representatives to explore way that information technology can enhance exhibits (Heath & Vom Lehn, 2010). There is a strong connection between interactivity, engagement and learning. Together, they can form the foundation for the development of successful digital environments; an interactive "play space" that allows children to engage in creative and constructive play, and encounter the educational and recreational experiences (Roussou 2010, 252). When combining learning and leisure for children, interactivity is essential; experiences should be structured around interactivity (Roussou 2010, 260). Tangible interaction offers new ways to engage visitors with digital systems through material means. The technology is intentionally concealed to bring places and stories from the past into the present and create immersive experiences where technology complements heritage (Petrelli et al., 2016).

*Conclusion*

This literature is significant in the design and development of the project mentioned in the next chapter because it outlines the best way to create an enhanced, playful, learning environment for children in a museum setting combining both physical and digital spaces. It lays the foundation for how people experience museums in general, but also discusses how learning, in both physical and digital spaces, occurs within museums. The museum experience is what happens before, during and after someone visits a museum (Henry, 2000). One way to make a meaningful museum experience is by placing museum visitors at the center of an activity (Rudman, 2008). However, exhibit developers must know and understand museum visitors before being able to implement such an activity. Falk's visitor experience model describes the different types of museum visitors, their view and which identity-related needs the museum supports (Falk, 2009).

Each museum visitor experiences a museum differently because events and observations are absorbed differently based on personal significance (Falk & Dierking, 1992). Falk's Contextual Model of Learning promotes understanding and organization of the complexity of learning, which is the process and product of the interactions between personal, sociocultural and physical context Falk and Dierking, 2000). Learning in museums is considered free-choice learning and can be experienced on a more personal level, compared to the typical school environment filled with expectations and progress (Falk, 2009). An exceptional method for maintaining a more pleasurable learning experience is through play. Children must move, use their senses and interact with other children (Strauss, 2015). In the museum environment, guided play - a playful, child-centered approach to learning - allows children to do these things with an educational purpose. Incorporating play in museums is unique to the contexts, the educators' experience, the museum collections and the age and interest of the visitors.

Museum visitors become engaged with their immediate environment. Therefore, both physical and digital spaces within a museum exhibit determine the effectiveness of transferring information to museum visitors. The physical environment is linked to ways in which people learn and the digital environment enriches the visitors’ enjoyment, providing opportunities to explore and create models of real-world systems. The challenge museums face is incorporating technologies at the intersection of digital and physical spaces. When combining learning and leisure for children, interactivity is essential. The strong connection between interactivity, engagement and learning form the foundation for the development of successful, interactive spaces that allows children to engage in creative and constructive play, and encounter the educational and recreational experiences (Roussou 2010).

## CHAPTER THREE: PROJECT DESIGN

This chapter outlines the phases of development for an interactive experience designed for integration with the *Dinosphere* exhibit at the Children's Museum of Indianapolis. The *Dinosphere* exhibit is meant to foster free play, which is influenced by personal wants and needs of an individual that usually happen outside of the structured school or classroom. This interactive experience is meant to foster guided play, which allows children to independently explore in a structured learning environment. The project was created through two main activities: 1) design thinking research of museum visitors, members of the target audience, and paleontologist experts and 2) iterative design and development.

During the research phase, preliminary ethnographic research was conducted at the Children's Museum of Indianapolis to determine the different ways museum visitors interact with physical and digital spaces of an exhibit. Additionally, a brainstorming session with members of the Children's Museum staff was held to determine constraints and key requirements for the experience. Further brainstorming sessions were held with children between the ages of five and 12 to better understand specific components children enjoy when it comes to museum environments. Semi-structured interviews with professors from various universities in the paleontology field were also conducted to better understand important information children of the target audience should know about paleontology, and also to gather ideas about paleontology-related activities.

In the development phase, the constraints were used in collaboration with professors in the paleontology field to create seven paper sketches of activities. These sketches were then tested with three five to 12 year olds. Following, two additional sketches were created based on usability and user experience feedback. Based on all sketches and solutions, high-fidelity, digital prototypes for three activities were created using Adobe Digital Publishing Studio, a software tool for developing interactive apps. Subsequently, a study that compared the existing *Dinosphere* experience to this new one was conducted by another master's degree student in Ball State's Center for Emerging Media

Design and Development and reported in her thesis, “*Dinosphere*: A Day in the Life - Usability and User Experience Research for Meaningful Play” (Kitchel, forthcoming).

**Partnering Organization**

With more than one million visitors annually, The Children’s Museum of Indianapolis is the world’s largest children’s museum. One of the museum’s core values is family learning, and most exhibits are designed to be interactive, allowing children and families to actively participate. During the exhibit development phase for most exhibits, an exhibit design team discusses the goals for the exhibit messaging, typically expressed in a single statement; this is called the Big Idea. Everything in the exhibit works together to deliver the one message.

Members of the Children’s Museum exhibit development staff provided valuable insights that guided the development of this project, from their own perceived weaknesses of the *Dinosphere* exhibit to feedback they regularly receive from museum visitors about the exhibit. The museum also granted permission for ethnographic research and usability/user experience research to be conducted in the *Dinosphere* exhibit to inform this project.

**Target audience**

According to the Children’s Museum of Indianapolis’ 2008 Profile Assessment of Family Learning research, the *Dinosphere* exhibit audience is primarily comprised of male children aged three to five. However, the target audience for this creative project is all children aged eight to 12, primarily because one of the goals is to expand the audience of the exhibit. In addition, the combination of the age categories defined by the software industry and the developmental stages psychologist Jean Piaget described, children from eight to 12 prefer play activities that emphasize rules, order, and predictability. They also enjoy testing their reasoning skills. Children early in this age group are also enjoy fantasy pastimes, such as games that allow them to try out different roles (Miller, 2014).

***Dinosphere* exhibit**

The *Dinosphere* exhibit is intended to transport visitors back in time more than 65 million years to the land of the dinosaurs. According to the exhibit development team, the "big idea" behind the *Dinosphere* is, "You can study fossils to search for clues about dinosaurs." Each individual segment of the exhibit includes additional subject specific information. Seven main exhibit areas comprise the *Dinosphere*, all of which are defined in Table 1. The additional information included in each segment of the exhibit can be found in Appendix A.

| | |
|---|---|
| ***T. rex Attack*** **(Bucky, Stan & Kelsey)** | A scenario including skeletons of two *T. rex* and a *Triceratops* that explains what it was like to be at the top of the food chain; dangerous and short |
| ***The Watering Hole*** | A scenario from an early morning at a watering hole in the Cretaceous world including *Hypacrosaurus* and *Leptoceratops* |
| ***Scavenger or Predator*** | A scenario that displays a kill site including a *Gorgosaurus*, a *Maiasaurus* and Bambiraptors |
| ***Dig Site*** | A dig pit that allows visitors to use simple tools to dig for dinosaur bones |
| ***Leonardo the Mummified Dinosaur*** | A display of the mummy fossil of Leonardo with a presentation projected above the fossil |
| ***Paleo Prep Lab*** | A lab of real paleontologists that clean and prepare dinosaur bones |
| ***Eggs, Nest & Babies*** | Role-play with costumes, look at an egg scope, learn about Baby Louie and play an egg-matching/hatching computer game |

**Table 1. The seven *Dinosphere* exhibit spaces and descriptions**

**Research Phase**

A six-hour observation of visitors at the Children's Museum of Indianapolis' *Dinosphere* exhibit took place in Spring 2016. The purpose of this research was to determine the different ways that museum visitors engage with physical and digital exhibit elements. The key findings for this preliminary research demonstrated that physical spaces, as opposed to digital experiences, were the most popular areas within the exhibit. Likewise, researchers observed that the *Dinosphere* exhibit adequately displays artifacts in a way that draws attention and provides an engaging experience. However, children do not engage with the digital spaces in the exhibit as much as the physical spaces. One of the most significant findings was that children spent very minimal time with the digital spaces in the *Dinosphere* exhibit. During observations of the digital spaces in exhibit, there were common phrases heard from children, including:

- "I don't like the computer games."
- "I didn't play any of them."
- "I only wanted to dig for bones."

Following, a brainstorming session with members of the Children's Museum staff was held to determine constraints and key requirements for the experience. The session consisted of four prompts, each followed by a guided discussion. The complete protocol can be found in Appendix B. Key findings for this brainstorming session determined the project must:

- Have a focus and a clear flow;
- Include role-playing with a real world process;
- Combine learning and fun;
- Be organized with clear, friendly instruction.

Success for current museum exhibits is typically measured by duration of stay, repeat visits, and data from exit interviews. Success of this interactive experience will be determined by duration and repetition of exhibit visitation, behavior during the experience, and data received after visitors engage in the experience. Additional observations at the Children's Museum of Indianapolis' *Dinosphere* exhibit took place in Fall 2016 and Spring 2017. The purpose of this research was to further understand how museum visitors engage with physical and digital exhibit elements, how children interact with the context of dinosaurs and what kind of improvements children would like to see in the exhibit. Key findings from this research demonstrated that children enjoy pretend play, discovering new things and competitive, interactive games that require attention for a short amount of time.

A three-hour observation of the *Dinosaur Expedition* exhibit at the Chicago Children's Museum took place in Fall 2016. This exhibit is a re-creation of the Saharan expedition, during which Chicago paleontologist Paul Sereno discovered a new type of dinosaur. Along with a life-size skeleton of *Suchomimus* and skulls, teeth and claws of a *T. rex*, there is a large excavation pit for visitors to dig for bones, pretending to be part of Paul's expedition team. The purpose of the research was to determine specific ways children interact with the context of dinosaurs. The key findings for this research demonstrated that children enjoy pretend play and discovering new things. Key findings also demonstrate that things must be visible and grab the attention of children for them to even consider being engaged.

Also in Fall 2016, a focus group was conducted with five to 12 year olds concentrating on how children enjoy interacting with different areas of a museum. The students were recruited by a mass email sent through the Ball State University Communications Center. Ball State employees were asked to bring their children aged five to 12 to a focus group about dinosaurs and museum experiences. Prompts were designed to elicit what makes an experience most appealing to and understood by members of the target audience. Children were also asked to design a game around their favorite museum experience.The complete protocol can be found in Appendix C. Key findings from this brainstorming session resulted in two main themes: 1) children enjoy competition, and 2) children enjoy getting feedback and rewards.

In Spring 2017, 11 experts were recruited by email to participate in an interview related to paleontology and museums. Four professors, all from the University of Cincinnati, and one expert from Cincinnati Museum Center, agreed to participate and semi-structured interviews were conducted over the phone. Qualifications for these experts range from vertebrate paleontology, paleoecology, death assemblages, biogeochemistry and taphonomy. Questions were designed to elicit what children should know about paleontology and what possible activities could be designed for children related to paleontology. The complete protocol can be found in Appendix D.

**Design and Development Phase**

Using information from the semi-structured interviews with paleontology professors, eight activity ideas were brainstormed. Seven of those activities were transformed into low-fidelity sketches that were tested with members of the target audience. Feedback was used to make revisions and implement sketches into three, low-fidelity prototypes that were then tested with five to 12 year olds. Based on all low-fidelity prototypes and solutions, digital prototypes for three activities were created using Adobe Digital Publishing Studio, a software tool for developing interactive apps. Each of these activities corresponds with areas within the *Dinosphere* exhibit, expanding the audience and enhancing the overall experience of the exhibit.

***Dinosphere*: A Day in the Life**

Based on semi-structured interviews with paleontology professors, eight activity ideas were brainstormed:

1. *Missing Fossils*: Find Buck and Kelsey's missing fossils in the dig pit.
2. *Digital Treasure Hunt*: Identify which bones are dinosaurs, birds and humans.
3. *Bone Classification*: Compare fossils and bones from when dinosaurs were alive. Determine what each bone was used for. Did injuries affect daily life?
4. *Digital Geological Map*: Show a geological map of the United State in the Cretaceous period. Identify where the best place to look for dinosaur fossils is based on the geologic age.
5. *Dinomite Appetite*: What did these dinosaurs eat based on its body? Complete the food chain based on what each dinosaur ate.
6. *Layers of Time*: Put rock layers in order from oldest to youngest based on what has been preserved in each layer.

7. *Anatomy Adventure*: Put together fossils that were found and identify what kind of animal it is.
8. *Digital Prep Lab*: Browse around the prep lab and complete different paleontology activities.

**Low-fidelity sketches**

Six of the eight activity ideas developed in collaboration with paleontology professors were transformed into low-fidelity sketches. Figures 4-13 illustrate those sketches.

*Missing Fossils*

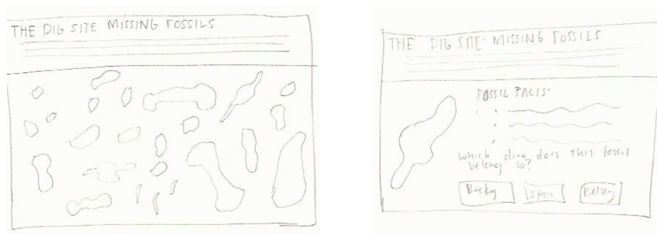


**Figure 4: Users tap the fossils they find in the dig pit and determine which dinosaur it belongs to.**

*Missing Fossils 2*


**Figure 5: Users tap fossils they find in the dig pit and determine where on the dinosaur it belongs.**

*Digital Treasure Hunt*

**Figure 6: Users look through a collection of bones and are timed while they determine if each of them are dinosaur, human or bird bones.**

*Digital Treasure Hunt 2*

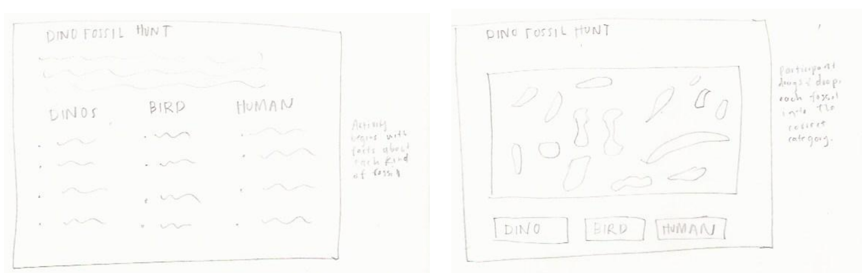


**Figure 7: Users look through a collection of bones and determine if each of them are dinosaur, human or bird bones.**

*Digital Geological Map*

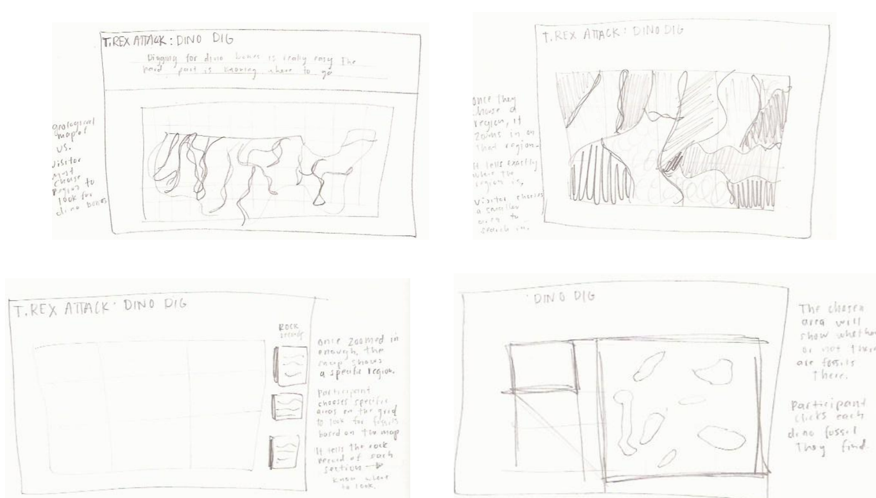


**Figure 8: Users use a digital, geological map to determine the best area in the United States to search for dinosaur fossils, then look for fossils in that area on the map.**

*Dinomite Appetite*

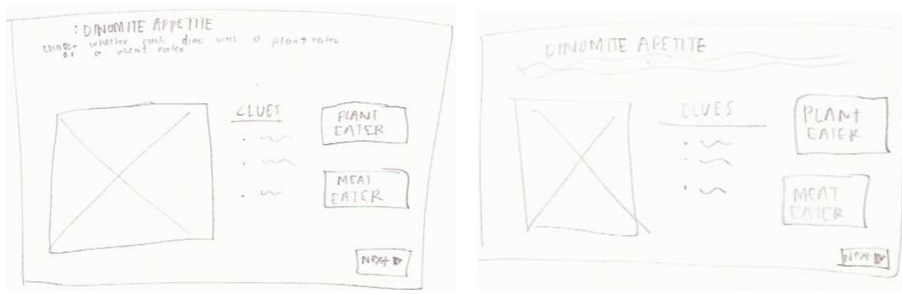


**Figure 9: Users use clues to determine whether each dinosaur was a meat or plant eater.**

*Layers of Time*

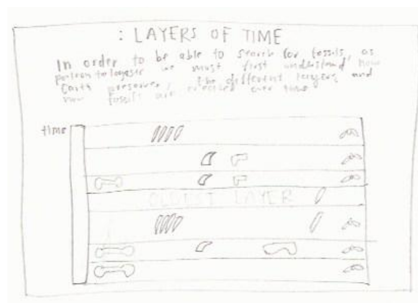


**Figure 10: Users rearrange layers of earth to determine the correct order based on time and preservation.**

*Anatomy Adventure*

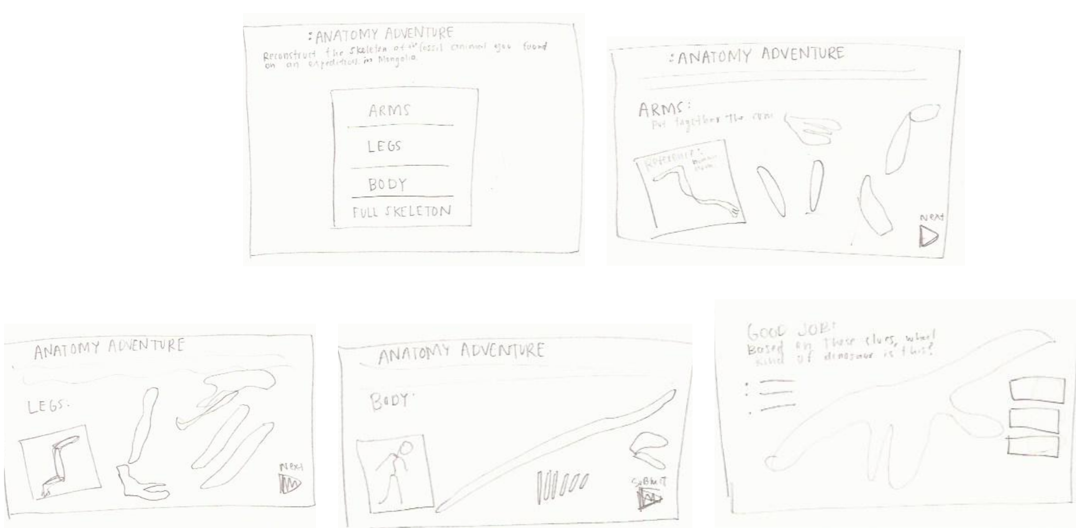


**Figure 11: Users put together the arms, legs and body of specific dinosaurs and use clues to determine what kind of dinosaur it is.**

Some of these activities did not meet the constraint of working in collaboration with a specific physical part of the *Dinosphere* exhibit. Based on feedback from paleontology professors, five to 12 year olds and the project advisor, two new activities were sketched from revisions and collaborations.

*Scene Selection*

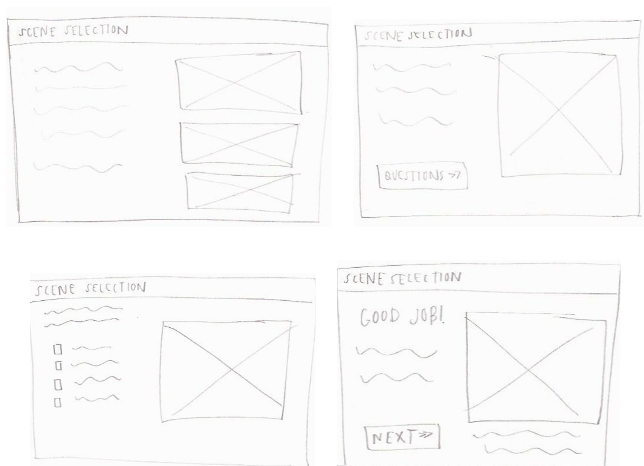


**Figure 12: Users read a storyline and determine which visual it matches, then find the scene in the exhibit and answer questions.**

*Prepare and Compare*

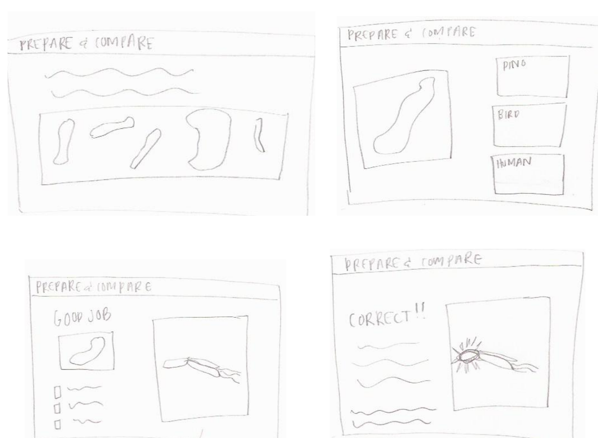


**Figure 13: Users remove fossils from their jackets, determine if they belong to a human, bird or *Triceratops,* then determine which arm bone it is.**

**High-fidelity, digital prototypes**

Based on feedback from paleontology professors, five to 12 year olds, and the project adviser, two three activities, *Missing Fossils, Scene Selection and Prepare and Compare,* were finalized and transformed into high-fidelity, digital prototypes.

This project was designed to work in collaboration with the *Dinosphere* exhibit in the Indianapolis Children's Museum in Indianapolis, Indiana. The experience gives visitors the opportunity to be in the shoes of a paleontologist for the duration of their visit in *Dinosphere.* The goal is to become an expert paleontologist. Three activities align with five different spaces within the exhibit. When visitors enter *Dinosphere*, they will decide whether they want to participate in the experience. If they do, they will be given an iPad that represents their paleo notebook and prompted to put on a lab coat. As shown in Figure 14, the initial screen will show the directions for the experience and a "Future Paleontologist" emblem.


**Figure 14. After users read the directions, they create a profile. Tapping "Create a Paleo Profile" advances the screen to Figure 15.**


**Figure 15. Users tap "Tap to take your picture" and the camera is launched. Once users take their picture they input their first and last name and by tapping "Generate Paleo Profile," the screen moves to see the user's Paleo Profiles (Figure 16).**

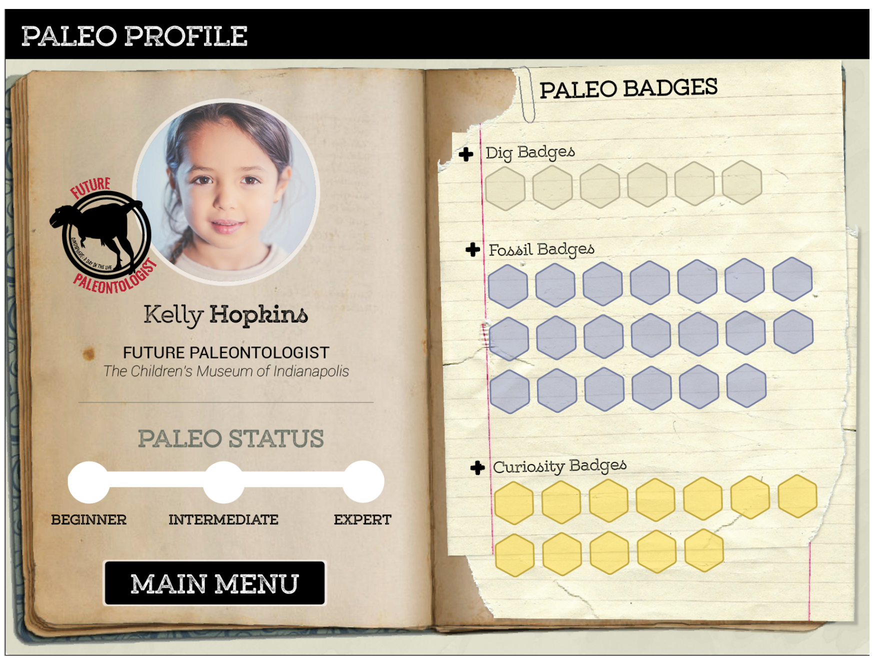


**Figure 16. The user's initial Paleo Profile shows the user's name, paleo status bar, how many badges are possible for each activity, and a description of how to earn each type of badge, which are shown in Figures 17, 18 and 19.**


**Figure 17. If users choose to learn how to earn a dig badge, they tap the "+" next to "Dig Badges," and the screen shows the dig badge information.**

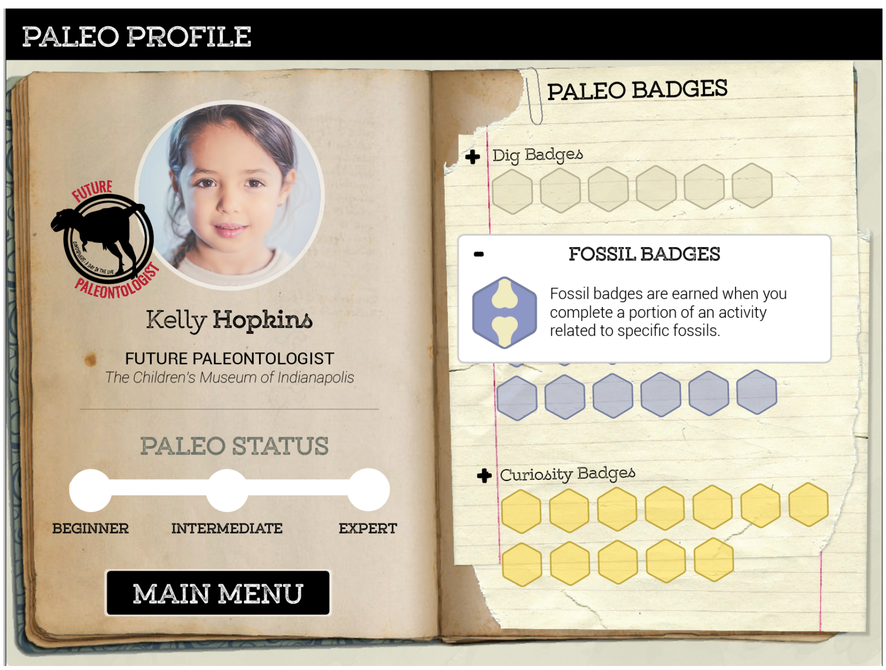


**Figure 18. If users choose to learn how to earn a fossil badge, they tap the "+" next to "Fossil Badges," and the screen shows the fossil badge information.**

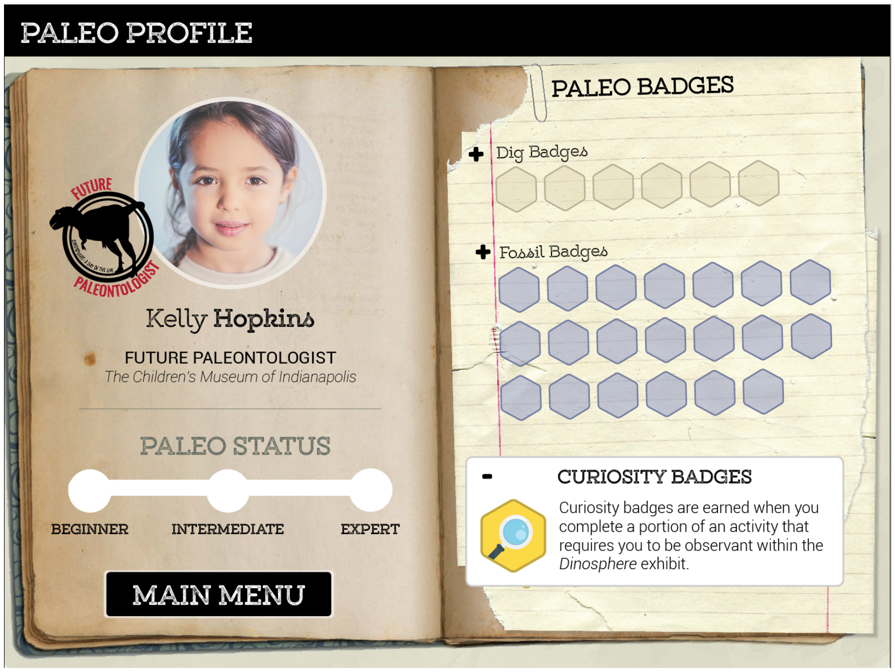


**Figure 19. If users choose to learn how to earn a curiosity badge, they tap the "+" next to "Curiosity Badges," and the screen shows the curiosity badge information. After users have reviewed the profile and how to earn each type of badge, they tap "Main Menu," and the screen will move to Figure 20.**

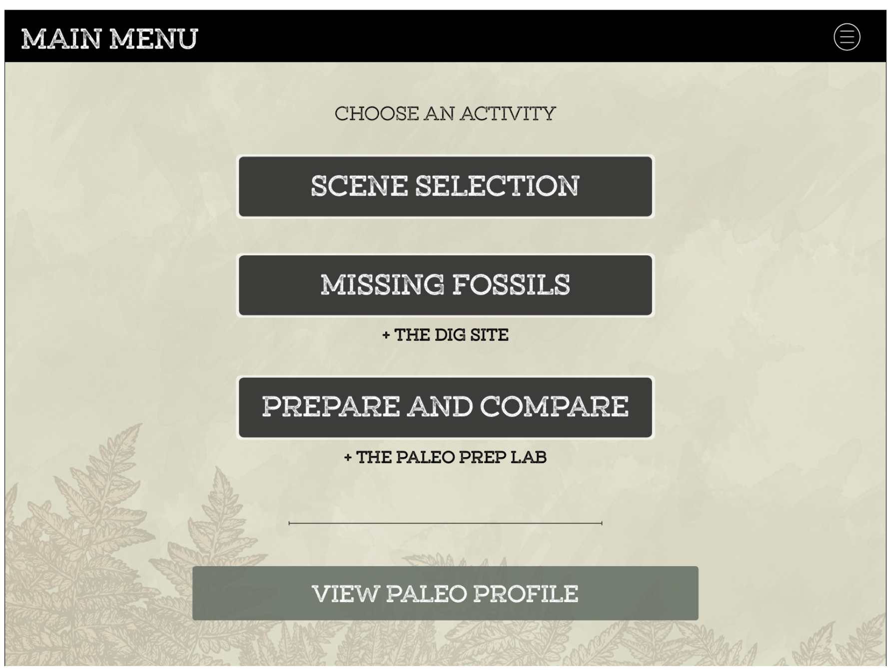


**Figure 20. The main menu shows each activity in the experience along with the option to return to users' paleo profile. "Scene Selection" is the first activity. To begin this activity, users tap on the name "Scene Selection," and the screen will move Figure 21.**

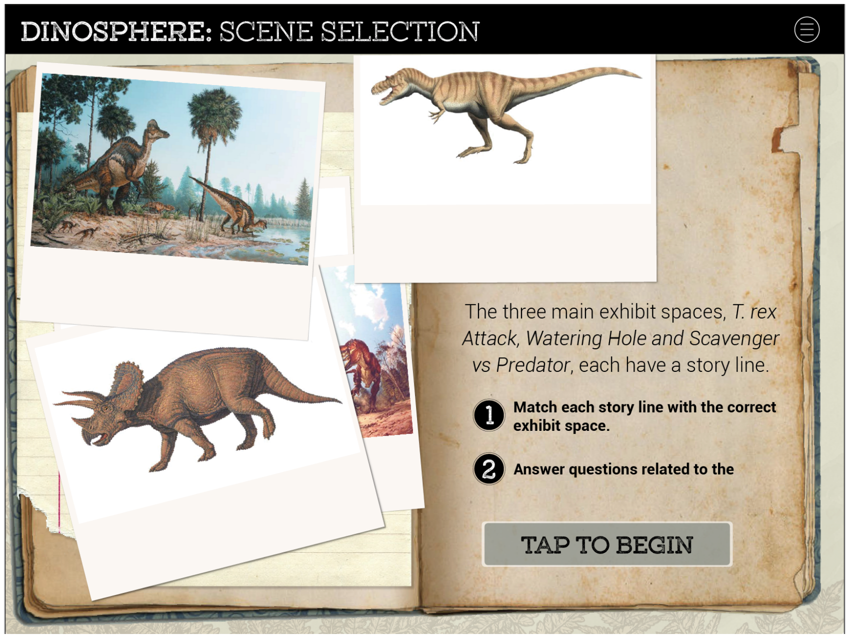


**Figure 21. The introduction to the *Scene Selection* activity informs users that the three exhibit spaces – *T. rex Attack, Watering Hole, and Scavenger vs Predator* – each have a specific story line. The activity directions prompt users to read each story, match it with the correct scene on the screen, find the scene in the Dinosphere exhibit, and answer three questions per scene. The answers to all of the questions are found in the specific exhibit space. The "Tap to Begin" button moves the screen to Figure 22.**

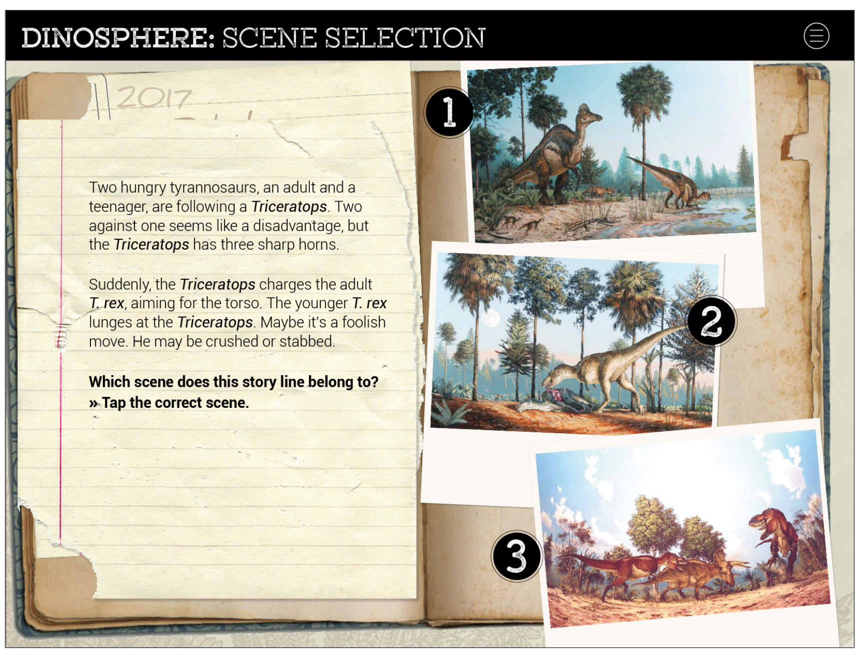


**Figure 22. After users reads the story, they must choose the picture that matches correctly. If their selection is incorrect, the screen moves to Figure 23. If their selection is correct, the screen moves to Figure 24.**


**Figure 23. Users are alerted if their selection is wrong. The "Try Again" button will take them back to Figure 22. From there, when they make the correct selection, the screen moves to Figure 24.**


**Figure 24. The correct scene appears on the screen with positive feedback and additional information and prompts the user to find the scene in the exhibit and answer a few questions. By tapping "Questions," the screen moves to Figure 25.**

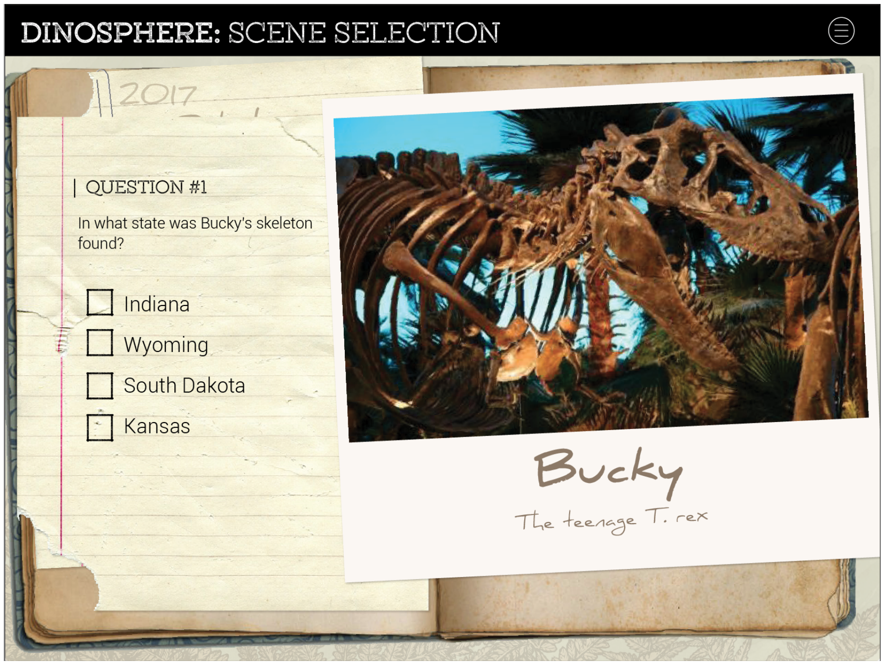


**Figure 25.** ***T. Rex Attack*** **Question 1. If the user answers incorrectly, the screen moves to Figure 26. If the participant answers it correctly, the screen moves to Figure 27.**

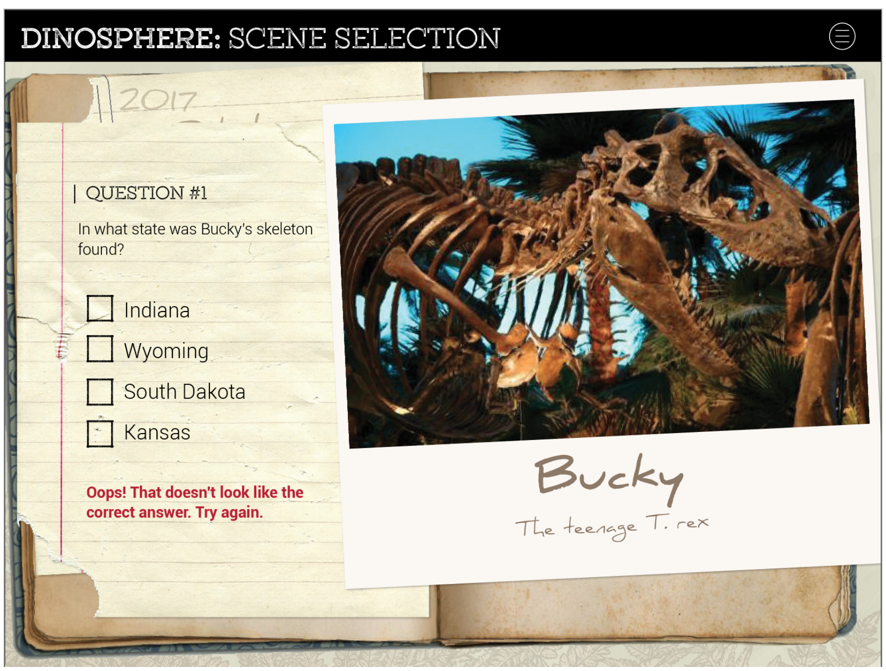


**Figure 26. After the correct answer is selected, the screen moves to Figure 27.**


**Figure 27. The correct answer is paired with a green checkmark and positive feedback. The "Next" button moves the screen to the next question (Figure 28).**


**Figure 28. *T. Rex Attack* Question 2. If users answer it incorrectly, the screen moves to Figure 29. If users answer it correctly, the screen moves to Figure 30.**


**Figure 29. Once the correct answer is selected, the screen moves to Figure 30.**


**Figure 30. The correct answer is paired with a green checkmark and positive feedback. The "Next" button moves the screen to the next question (Figure 31).**

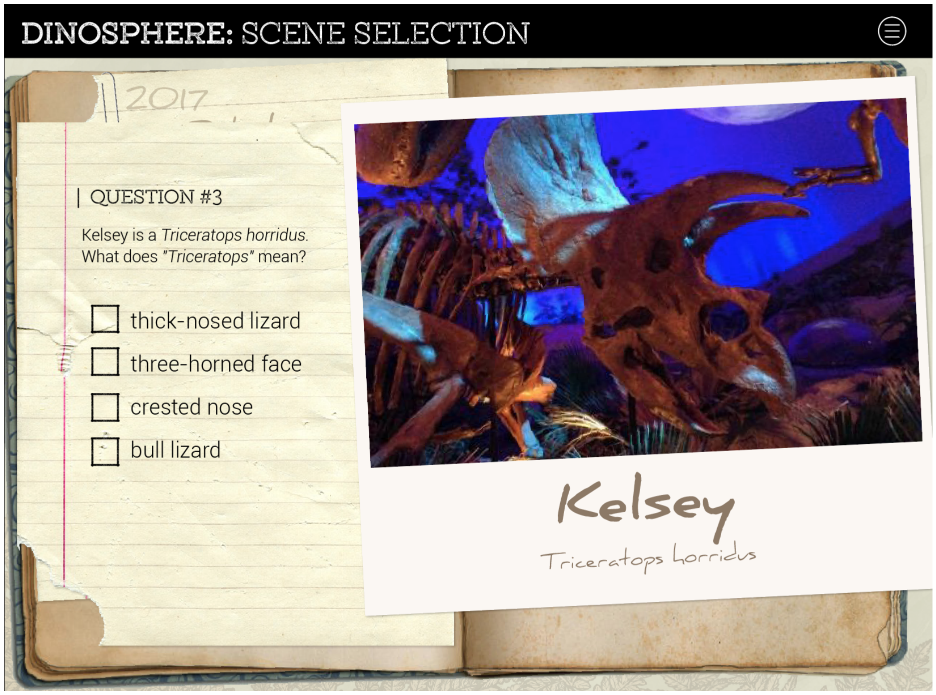


**Figure 31.** ***T. Rex Attack*** **Question 3. If users answer it incorrectly, the screen moves to Figure 32. If users answer it correctly, the screen moves to Figure 33.**

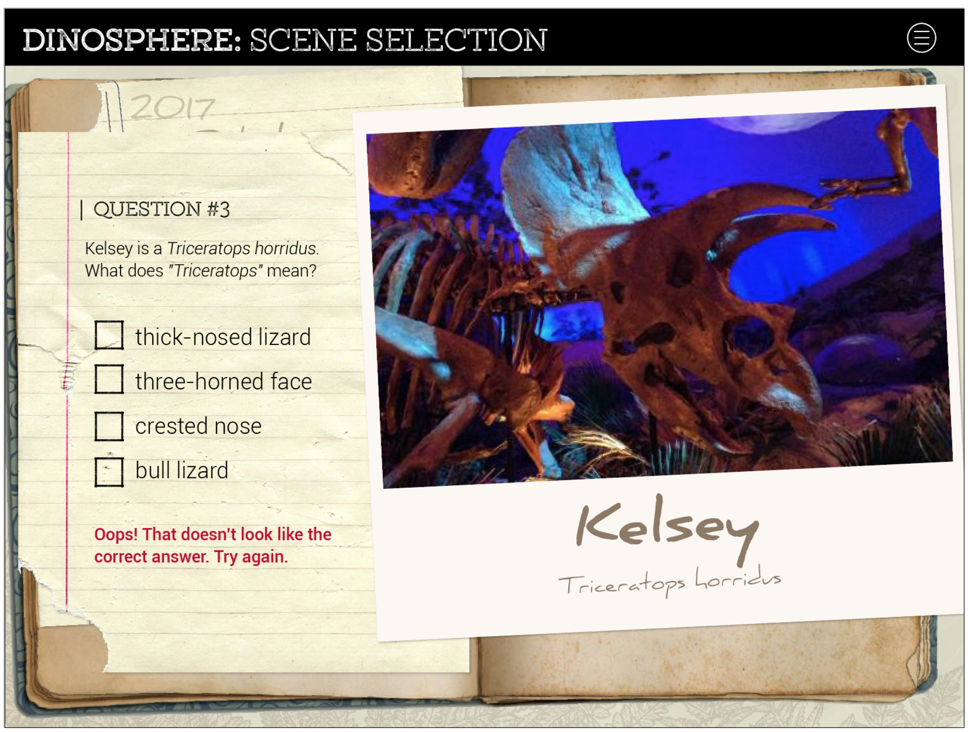


**Figure 32. Once the correct answer is selected, the screen moves to Figure 33.**


**Figure 33. The correct answer is paired with a green checkmark and positive feedback. The "Next" button moves the screen to the next story line (Figure 34).**

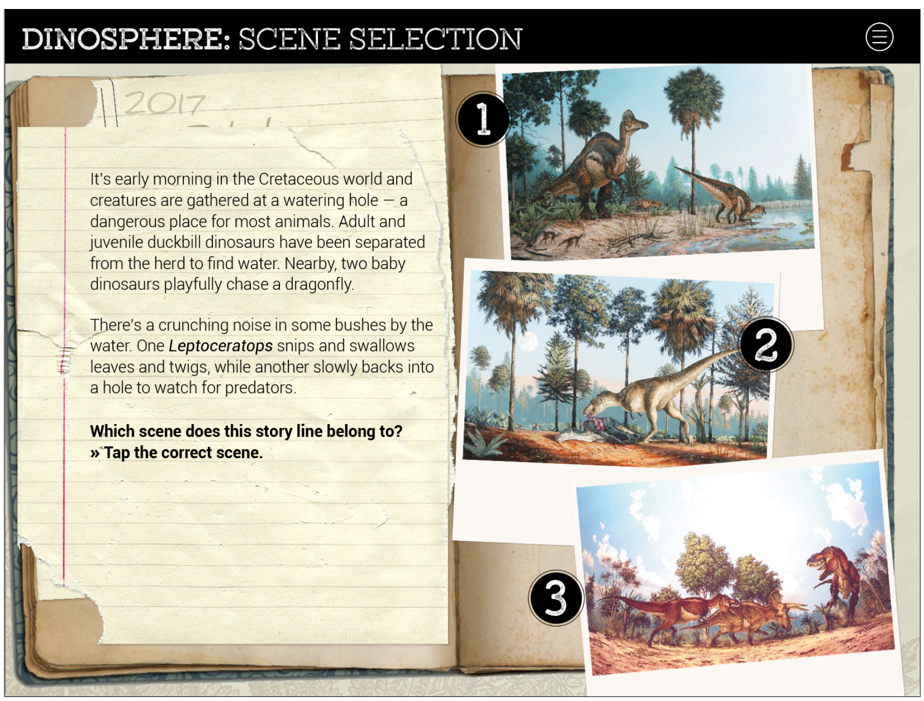


**Figure 34. Once users read the story line, they will choose the picture that matches correctly. If their match is incorrect, the screen moves to Figure 35. If their match is correct, the screen moves to Figure 36.**


**Figure 35. Users will be alerted that their selection was wrong. The "Try Again" button takes them back to Figure 34. From there, when they make the correct selection, the screen moves to Figure 36.**


**Figure 36. The correct scene appears on the screen with positive feedback and additional information and prompts users to find the scene in the exhibit and answer a few questions. By tapping "Questions," the screen moves to Figure 37.**

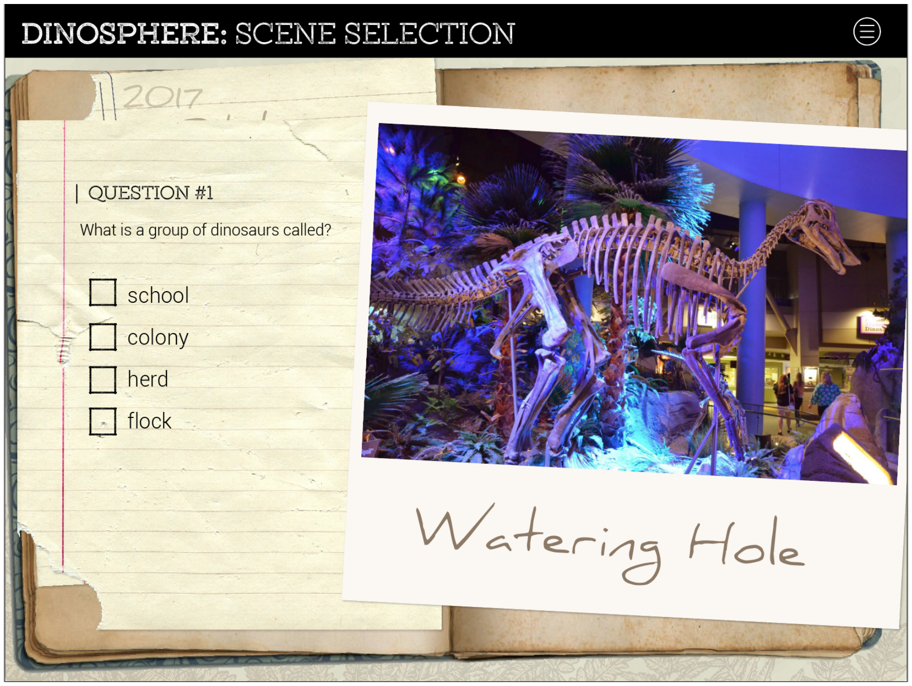


Figure 37. *Watering Hole* Question 1 . If users answer it incorrectly, the screen moves to Figure 38. If users answer it correctly, the screen moves to Figure 39.

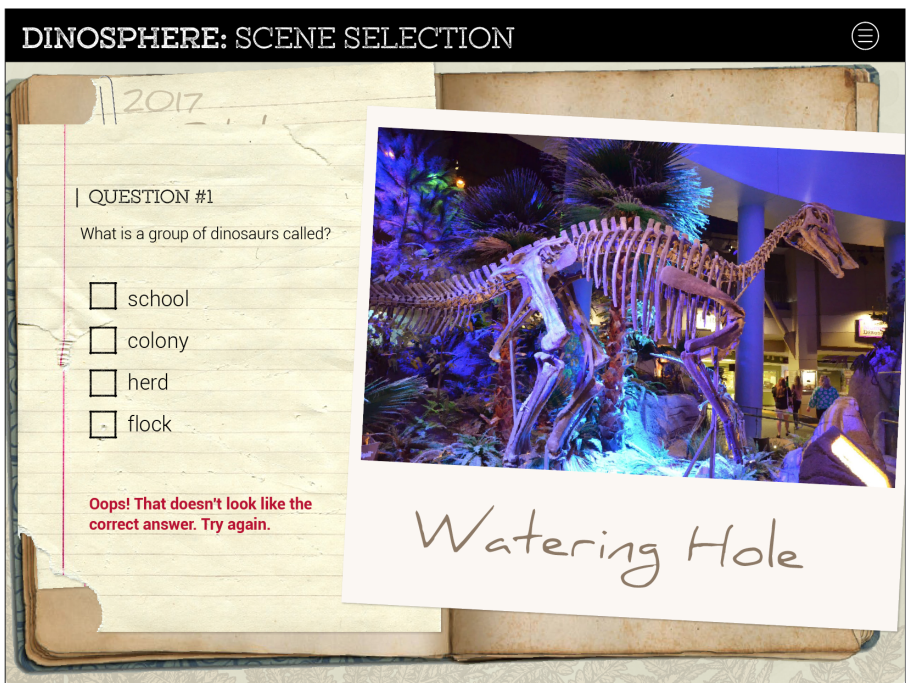


Figure 38.  Once the correct answer is selected, the screen moves to Figure 39.

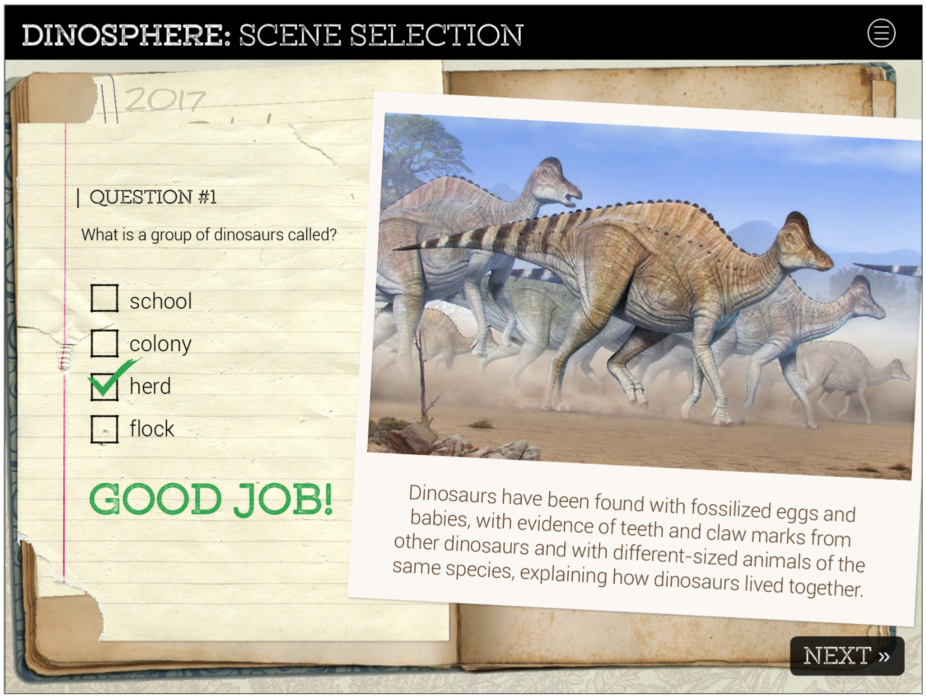


**Figure 39. The correct answer is paired with a green checkmark and positive feedback. The "Next" button moves the screen to the next question (Figure 40).**


**Figure 40.** ***Watering Hole*** **Question 2. If users answers it incorrectly, the screen moves to Figure 41. If users answer it correctly, the screen moves to Figure 42.**


**Figure 41. Once the correct answer is selected, the screen moves to Figure 42.**


**Figure 42. The correct answer is paired with a green checkmark and positive feedback. The "Next" button moves the screen to the next question (Figure 43).**

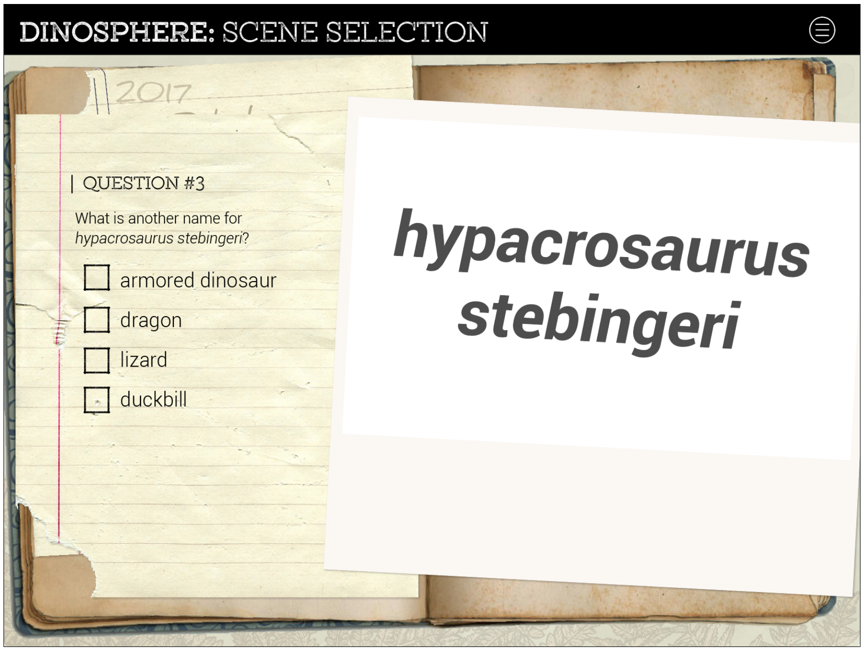


**Figure 43.** ***Watering Hole*** **Question 3. If users answer it incorrectly, the screen moves to Figure 44. If users answer it correctly, the screen moves to Figure 45.**

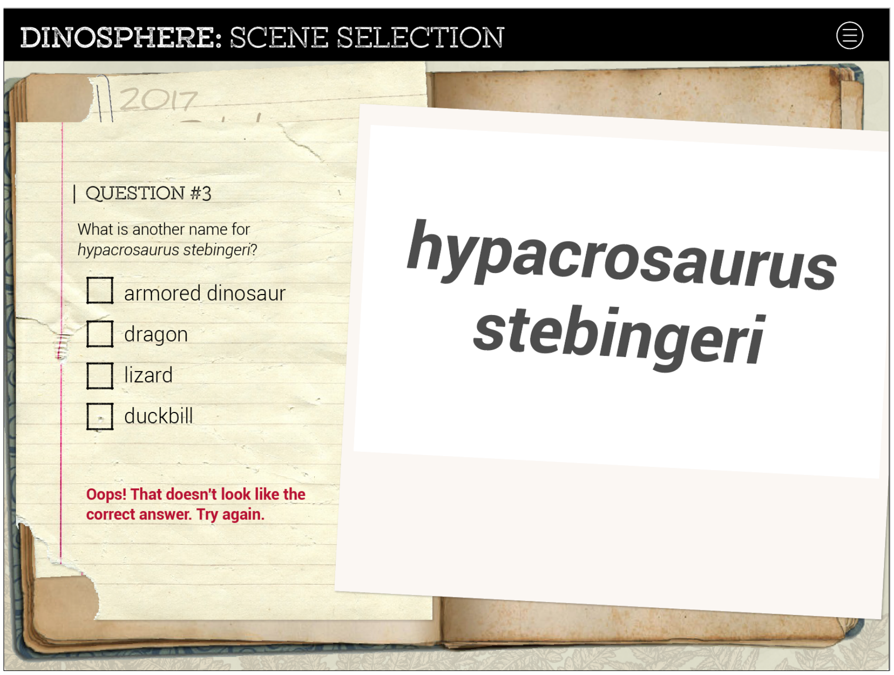


**Figure 44. Once the correct answer is selected, the screen moves to Figure 45.**


**Figure 45. The correct answer is paired with a green checkmark and positive feedback. The "Next" button moves the screen to the next story line (Figure 46).**

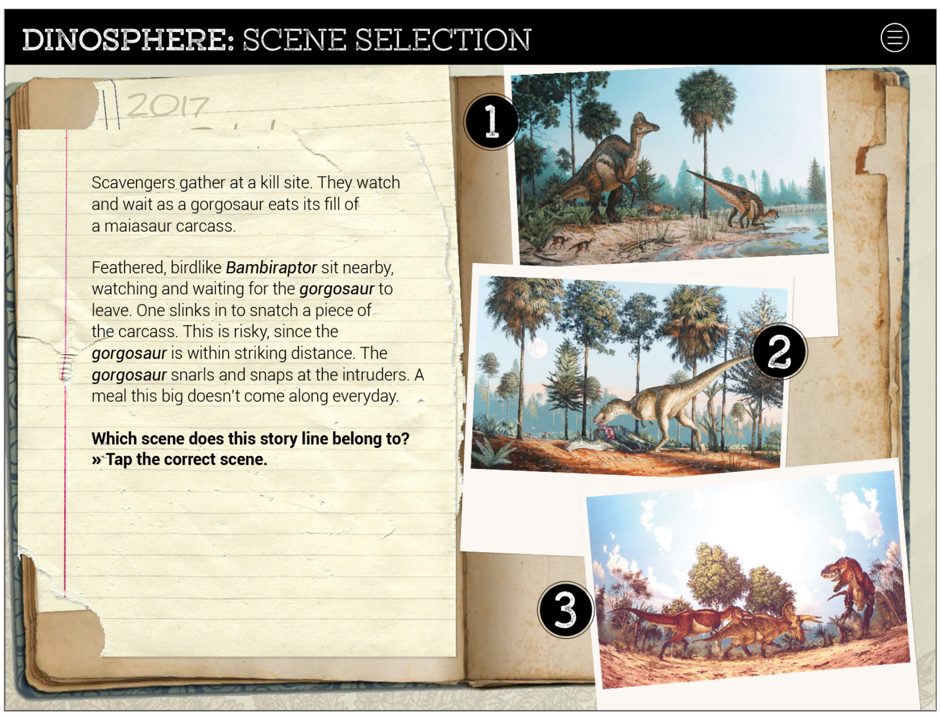


**Figure 46. Once users read the story line, they will choose the picture that matches correctly. If their match is incorrect, the screen moves to Figure 47. If their match is correct, the screen moves to Figure 48.**


**Figure 47. Users will be alerted that their selection was wrong. The "Try Again" button will take them back to Figure 46. From there, when they make the correct selection, the screen moves to Figure 48.**

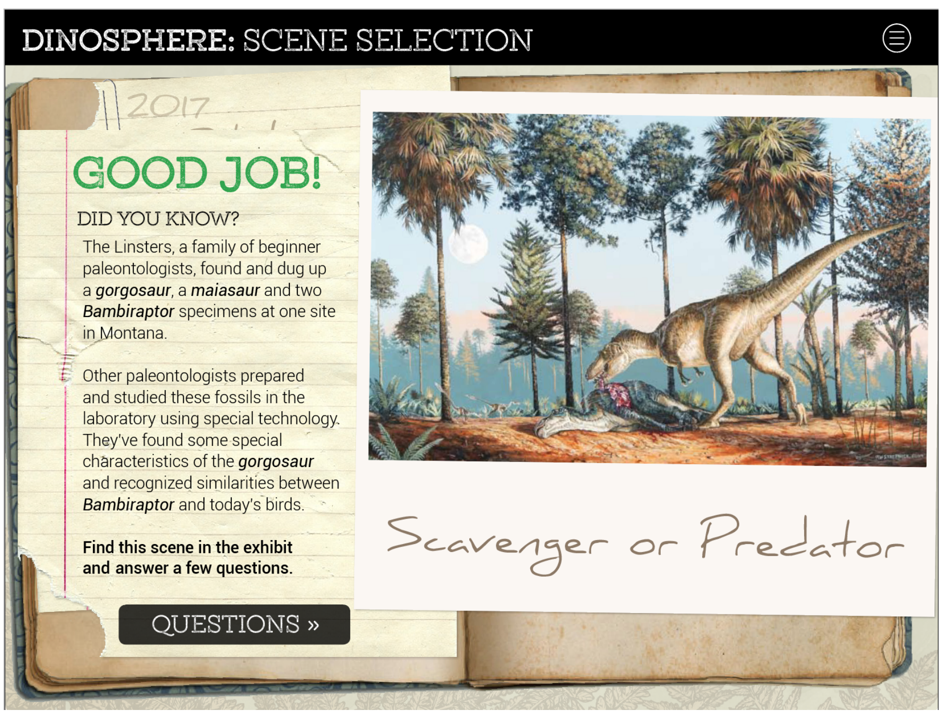


**Figure 48. The correct scene appears on the screen with positive feedback and additional information. Users find the scene in the exhibit and answer a few questions. By tapping "Questions," the screen moves on to Figure 49.**

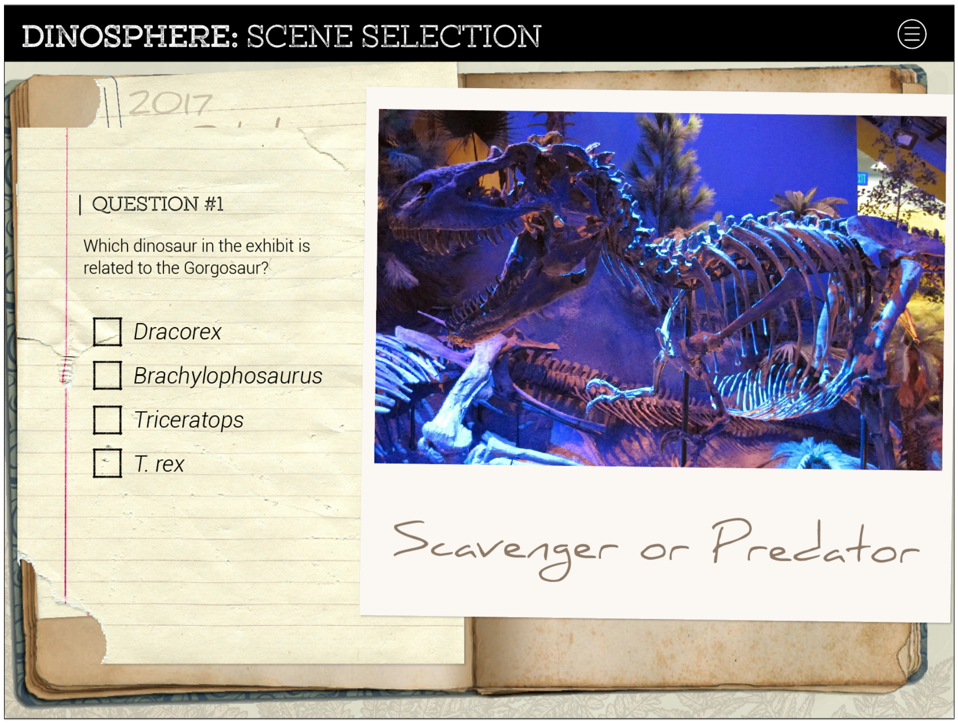


**Figure 49.** ***Scavenger or Predator*** **Question 1. If users answer it incorrectly, the screen moves to Figure 50. If users answer it correctly, the screen moves to Figure 51.**

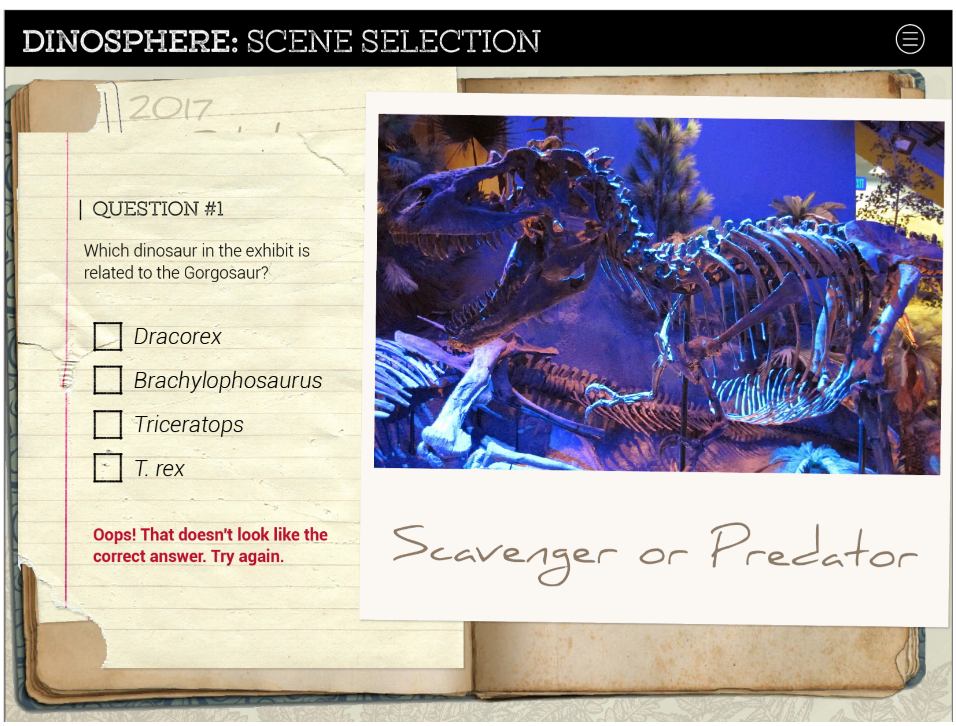


**Figure 50. Once the correct answer is selected, the screen moves to Figure 51.**

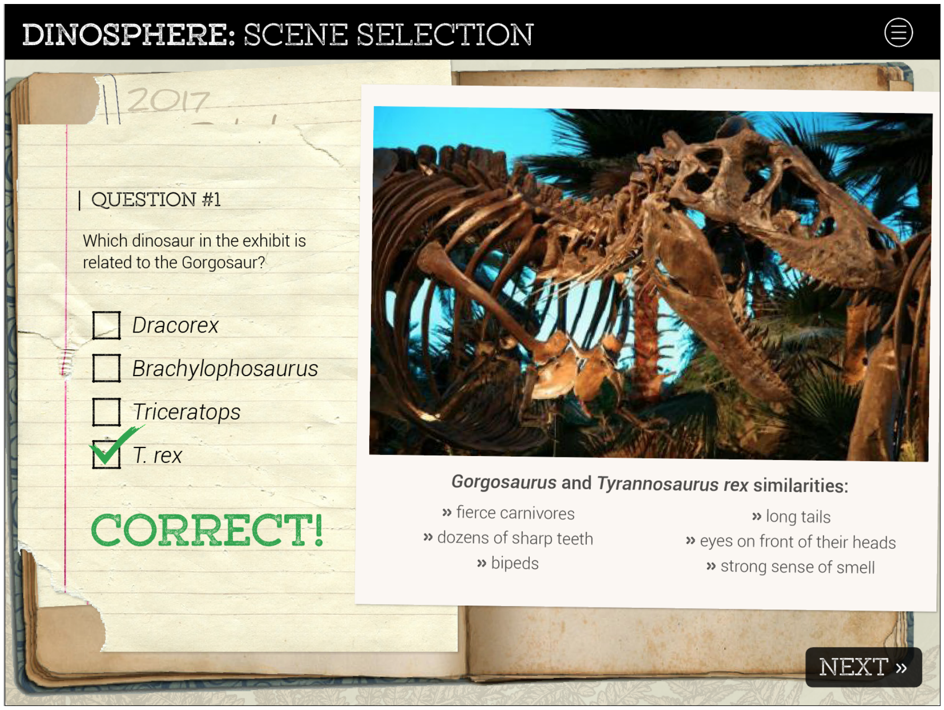


**Figure 51. The correct answer is paired with a green checkmark and positive feedback. The "Next" button moves the screen to the next question (Figure 52).**

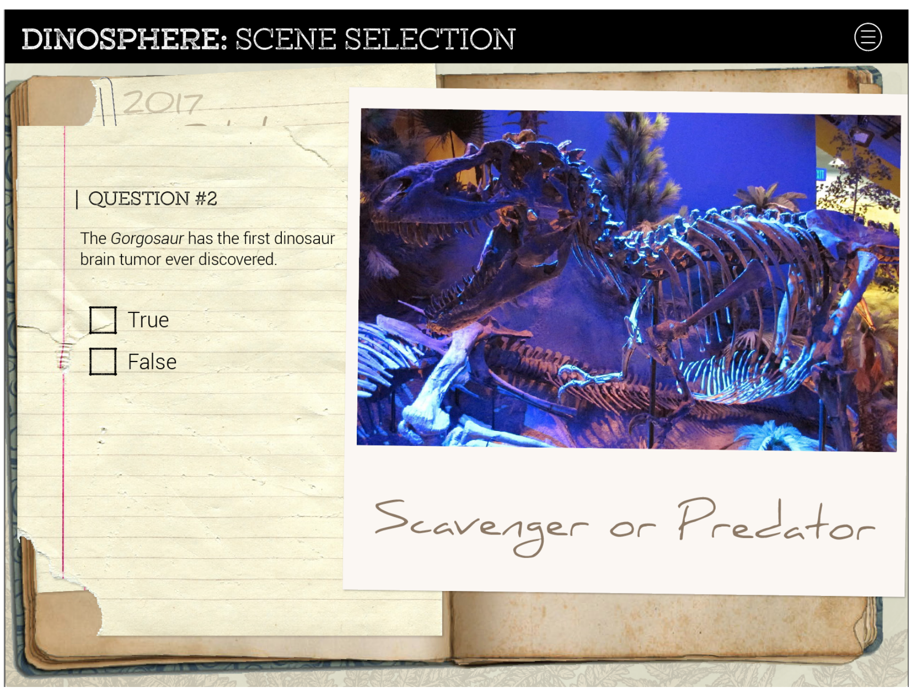


**Figure 52. *Scavenger or Predator* Question 2. If users answer it incorrectly, the screen moves to Figure 53. If users answer it correctly, the screen moves to Figure 54.**


**Figure 53. Once the correct answer is selected, the screen moves to Figure 54.**

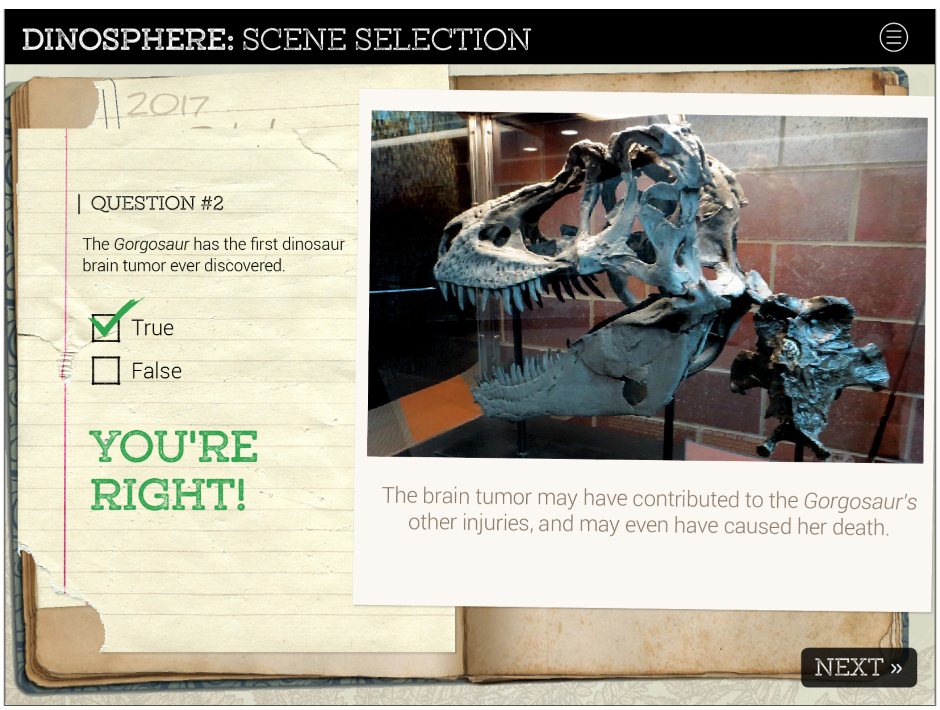


**Figure 54. The correct answer is paired with a green checkmark and positive feedback. The "Next" button moves the screen to the next question (Figure 55).**

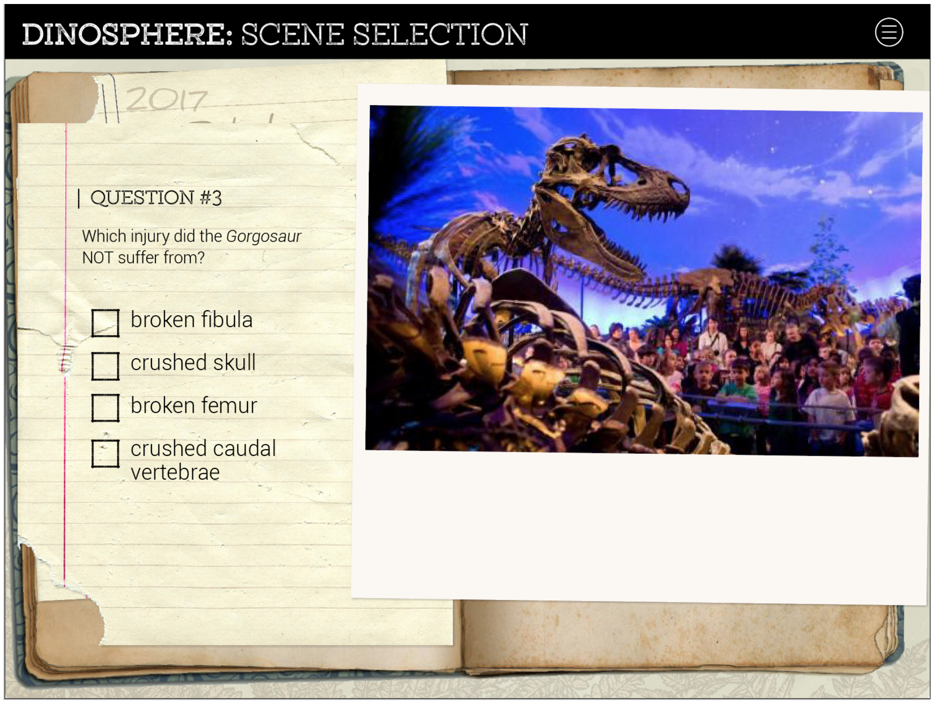


**Figure 55.** ***Scavenger or Predator* Question 3. If users answer it incorrectly, the screen moves to Figure 56. If users answer it correctly, the screen moves to Figure 57.**


**Figure 56. Once the correct answer is selected, the screen moves to Figure 57.**


**Figure 57. The correct answer is paired with a green checkmark and positive feedback. The "Next" button moves the screen to the overview of the activity (Figure 58).**


**Figure 58. The overview of the activity shows how many of each badge was earned and the total number of badges earned. By tapping "View Paleo Profile," the screen moves to Figure 59.**

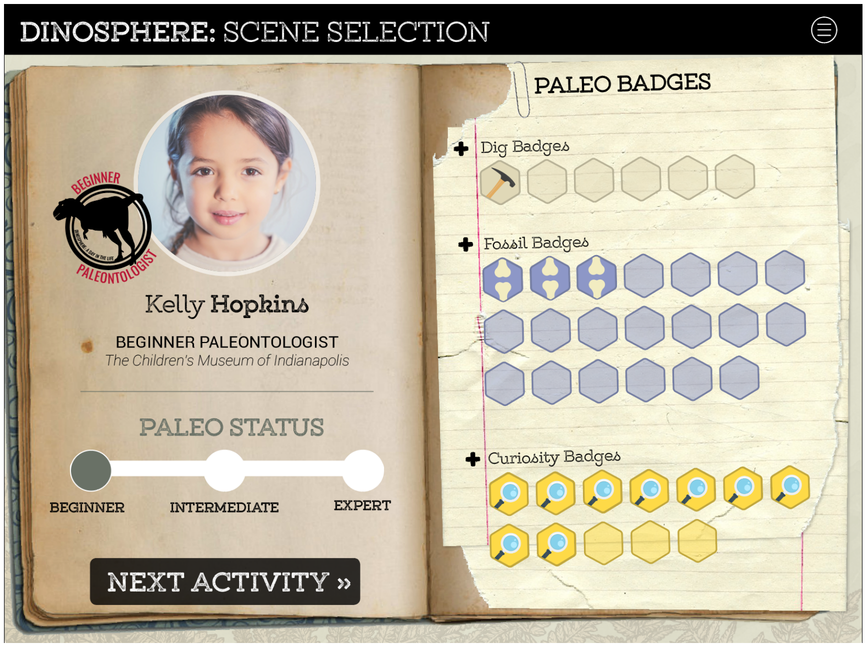


**Figure 59. The users Paleo Profile shows their new paleo status and an overview of the badges earned and how many badges are left to receive. By tapping "Next Activity," the screen moves to the *Missing Fossils* activity introduction page (Figure 60).**

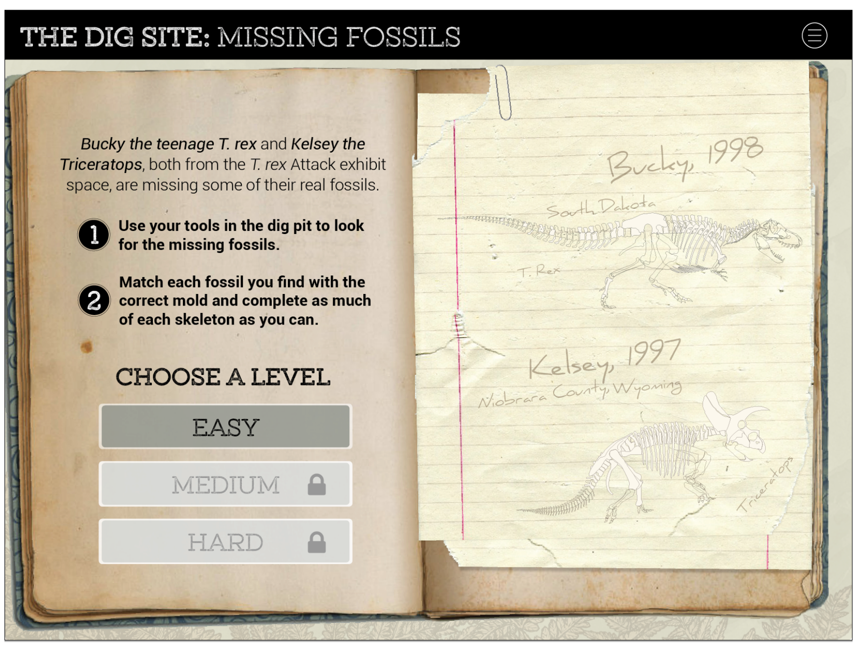


**Figure 60. Introduction to the *Missing Fossils* activity. It informs users that two of the dinosaur skeletons (Bucky, *T. Rex* and Kelsey, *Triceratops*) from the *T. Rex Attack* exhibit space are missing some of their real fossils. The directions prompt users to use the tools in The Dig Pit (an existing space in the *Dinosphere* exhibit) to look for the missing fossils, then match each fossil found with the correct mold on the screen to complete as much of each skeleton as possible. By tapping "Easy," the screen moves to Figure 61.**


**Figure 61. Once users search and find a fossil in the dig pit, they will match the fossil with the correct fossil shown on the screen. The underground view of the fossils scrolls left and right to allow more viewing. By tapping on the first specific fossil, the screen moves to Figure 62.**

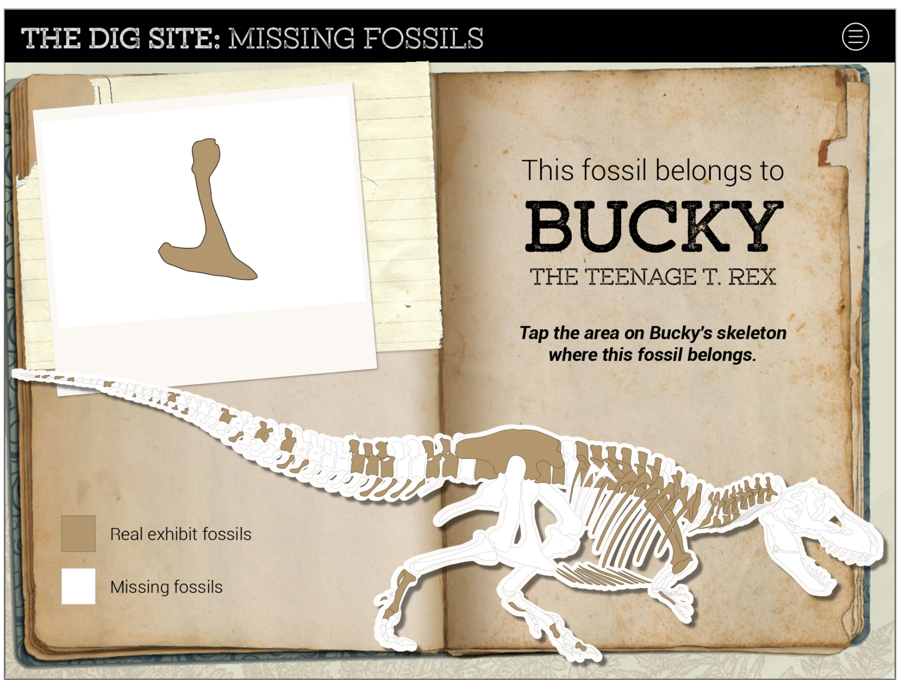


**Figure 62. The screen tells users which dinosaur the fossil belongs to. A skeleton outline of the dinosaur appears on the screen showing the real fossils that already exists in the exhibit skeleton and the missing fossils the participant is looking for. Users tap the area on the skeleton where the fossil belongs. If the selection is incorrect, the screen moves to Figure 63. If the selection is correct, the screen moves to Figure 64.**


**Figure 63. Once the correct area is selected, the screen moves to Figure 64.**


**Figure 64. The correct fossil is highlighted on the skeleton along with positive feedback and a fun fact about the fossil and/or dinosaur. The "Next Fossil" button moves the screen back to view all of the missing fossils (Figure 65).**


**Figure 65. Once users search and find another fossils in the dig pit, they will match the fossil with the correct fossil shown on the screen. The underground view of the fossils scrolls left and right to allow more viewing. By tapping on the second specific fossil, the screen moves to Figure 66.**

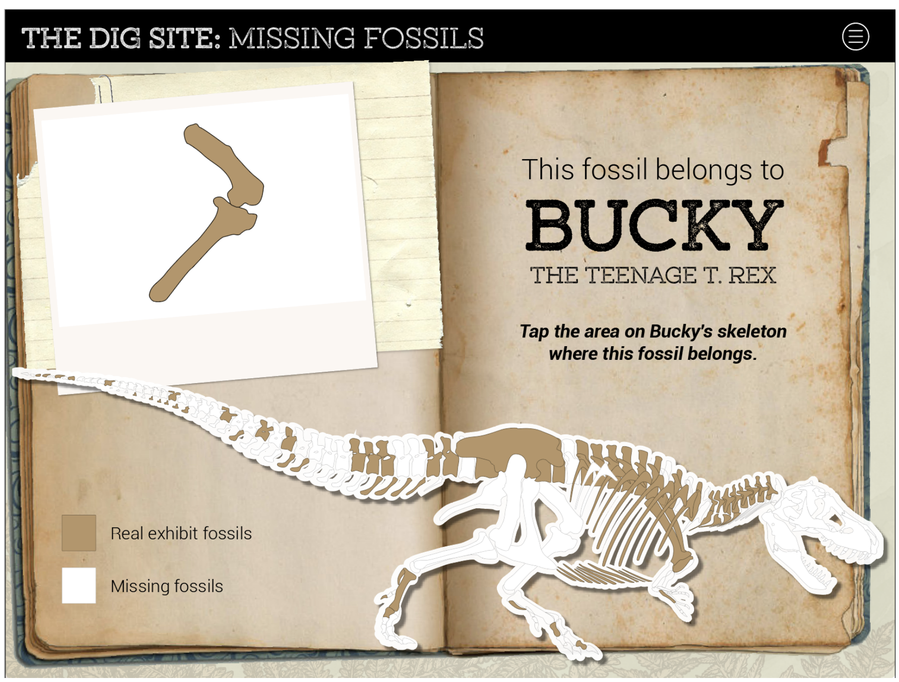


**Figure 66. The screen tells the users which dinosaur the fossil belongs to. A skeleton outline of the dinosaur appears on the screen showing the real fossils that already exists in the exhibit skeleton and the missing fossils the participant is looking for. Users are prompted to tap the area on the skeleton where the fossil belongs. If the selection is incorrect, the screen moves to Figure 67. If the selection is correct, the screen moves to Figure 68.**


**Figure 67. Once the correct area is selected, the screen moves to Figure 68.**


**Figure 68. The correct fossil is highlighted on the skeleton along with positive feedback and a fun fact about the fossil and/or dinosaur. The "Next Fossil" button moves the screen back to view all of the missing fossils (Figure 69).**


**Figure 69. Once users search and find another fossil in the dig pit, they will match the fossil with the correct fossil shown on the screen. The underground view of the fossils scrolls left and right to allow more viewing. By tapping on the third specific fossil, the screen moves to Figure 70.**

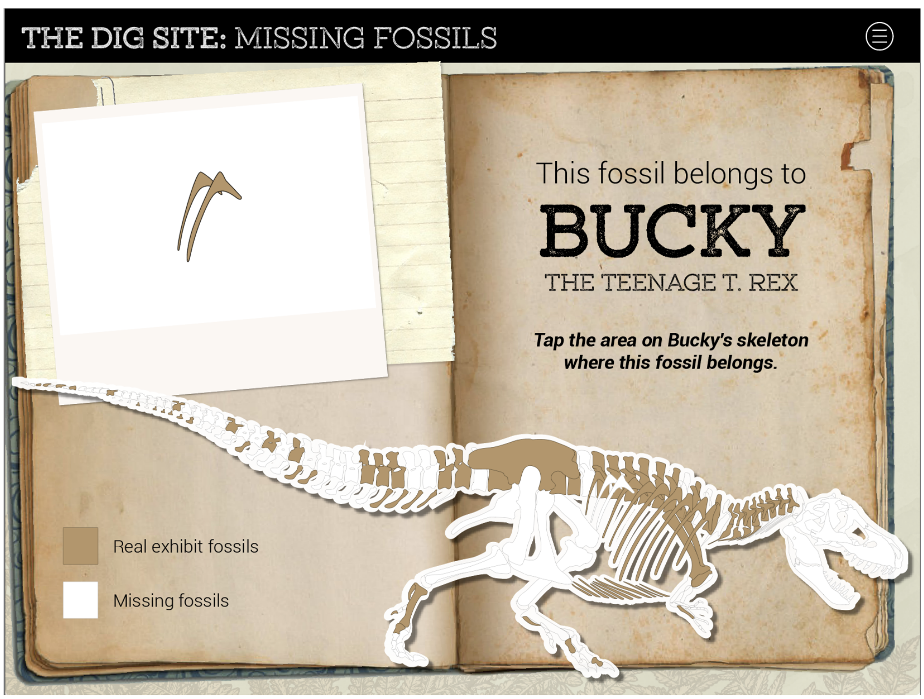


**Figure 70. The screen tells users which dinosaur the fossil belongs to. A skeleton outline of the dinosaur appears on the screen showing the real fossils that already exists in the exhibit skeleton and the missing fossils the participant is looking for. Users are prompted to tap the area on the skeleton where the fossil belongs. If the selection is incorrect, the screen moves to Figure 71. If the selection is correct, the screen moves to Figure 72.**


**Figure 71. Once the correct area is selected, the screen moves to Figure 72.**


**Figure 72. The correct fossil is highlighted on the skeleton along with positive feedback and a fun fact about the fossil and/or dinosaur. The "Next Fossil" button moves the screen back to view all of the missing fossils (Figure 73).**


**Figure 73. Once users search and find another fossil in the dig pit, they will match the fossil with the correct fossil shown on the screen. The underground view of the fossils scrolls left and right to allow more viewing. By tapping on the fourth specific fossil, the screen moves to Figure 74.**


**Figure 74. The screen tells users which dinosaur the fossil belongs to. A skeleton outline of the dinosaur appears on the screen showing the real fossils that already exists in the exhibit skeleton and the missing fossils the participant is looking for. Users are prompted to tap the area on the skeleton where the fossil belongs. If the selection is incorrect, the screen moves to Figure 75. If the selection is correct, the screen moves to Figure 76.**


**Figure 75. Once the correct area is selected, the screen moves to Figure 76.**


**Figure 76. The correct fossil is highlighted on the skeleton along with positive feedback and a fun fact about the fossil and/or dinosaur. The "Next Fossil" button moves the screen back to view all of the missing fossils (Figure 77).**


**Figure 77. Once users search and find another fossil in the dig pit, they will match the fossil with the correct fossil shown on the screen. The underground view of the fossils scrolls left and right to allow more viewing. By tapping on the fifth specific fossil, the screen moves to Figure 78.**


**Figure 78. The screen tells users which dinosaur the fossil belongs to. A skeleton outline of the dinosaur appears on the screen showing the real fossils that already exists in the exhibit skeleton and the missing fossils the participant is looking for. Users tap the area on the skeleton where the fossil belongs. If the selection is incorrect, the screen moves to Figure 79. If the selection is correct, the screen moves to Figure 80.**

Figure 79. Once the correct area is selected, the screen moves to Figure 80.

Figure 80. The correct fossil is highlighted on the skeleton along with positive feedback and a fun fact about the fossil and/or dinosaur. The "Finish" button will move the screen to an overview of the activity (Figure 81).


**Figure 81. The overview of the activity shows how many of each badge was earned and the total number of badges earned. By tapping "View Paleo Profile," the screen moves to Figure 82.**

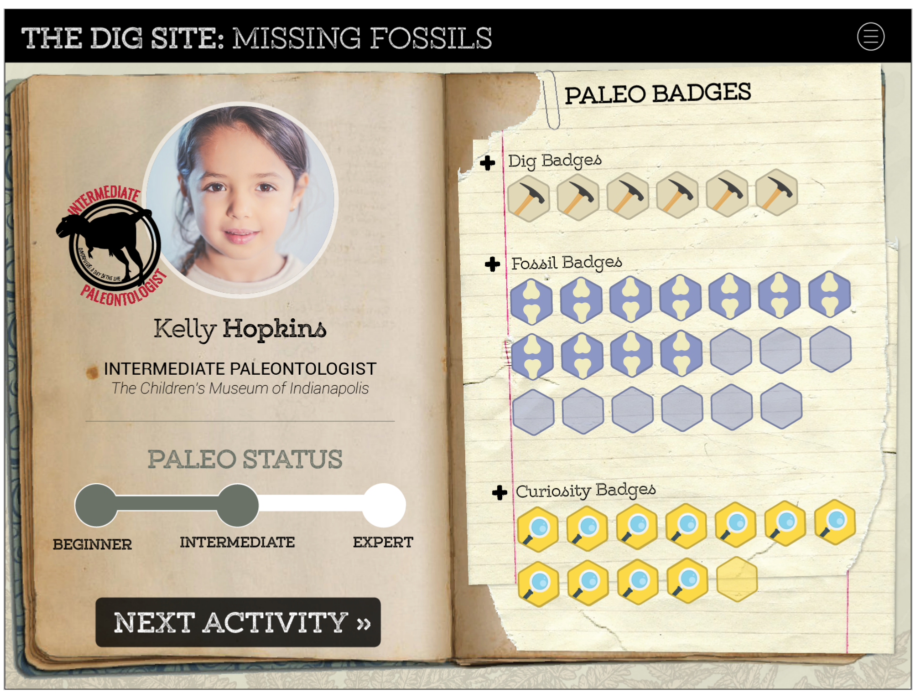


**Figure 82. The user's Paleo Profile shows their new paleo status and an overview of the badges earned and how many badges are left to receive. By tapping "Next Activity," the screen moves to the *Prepare and Compare* activity introduction page (Figure 83).**

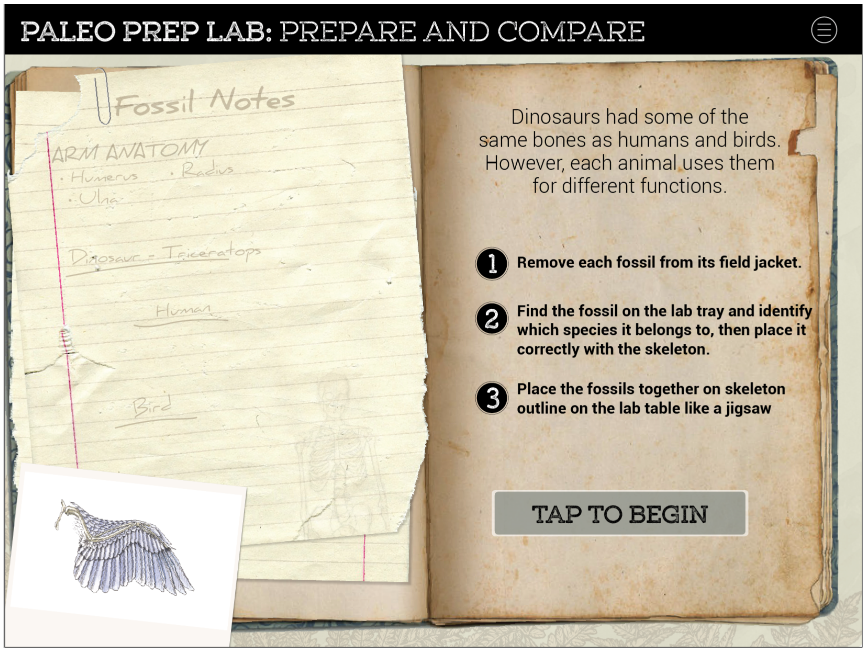


**Figure 83. Introduction to the *Prepare and Compare* activity. It tells users that dinosaurs had some of the same bones as humans and birds but that each animal used them for different functions. Directions prompt users to remove the fossils on the lab table from their field jackets, find the fossil on the lab tray on the screen, identify which species it belongs to and then place it with the correct skeleton. Once users have completed the digital portion of the activity, they will place the fossil on the outline on the lab table like a jigsaw puzzle. The "Tap to Begin" button moves the screen to Figure 84.**

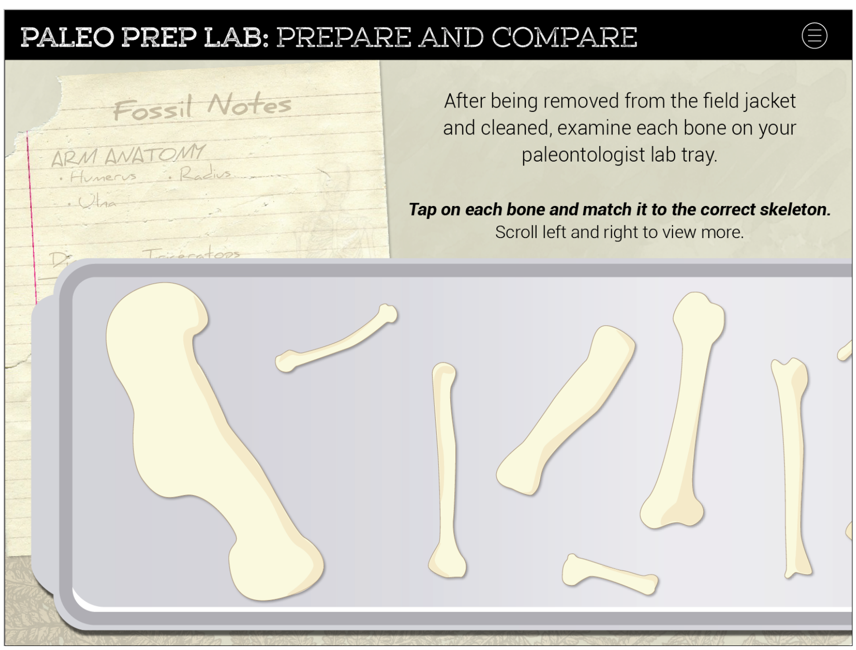


**Figure 84. Once users remove a fossil from its field jacket, they will find the fossil on the lab tray on the screen. The lab tray scrolls left and right to allow more viewing. By tapping the first fossil, the screen moves to Figure 85.**

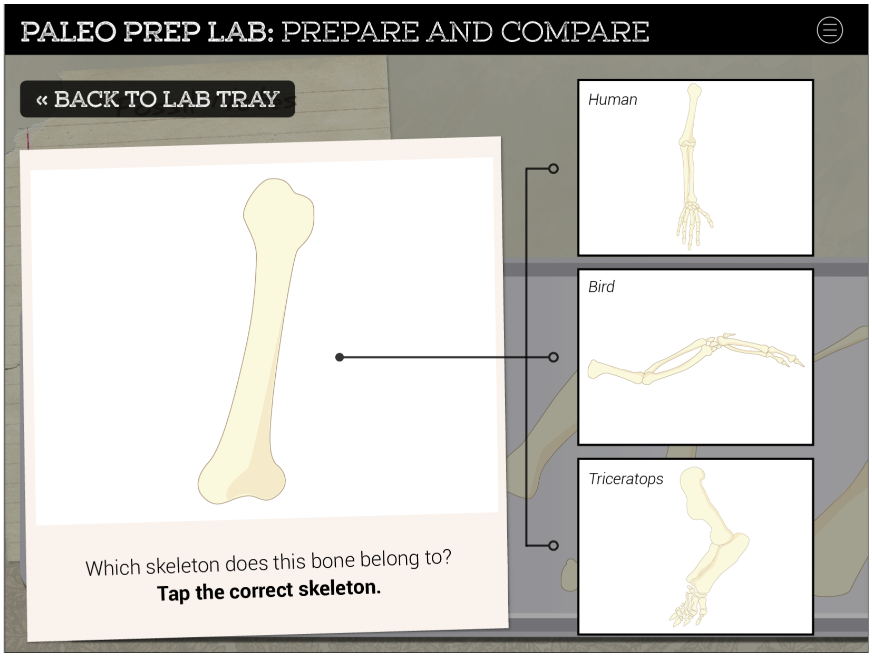


**Figure 85. The screen shows the enlarged bone and prompts users to tap the skeleton the bone belongs to (*Human, bird or Triceratops)*. If the selection is incorrect, the screen moves to Figure 86. If the selection is correct, the screen moves to Figure 87.**

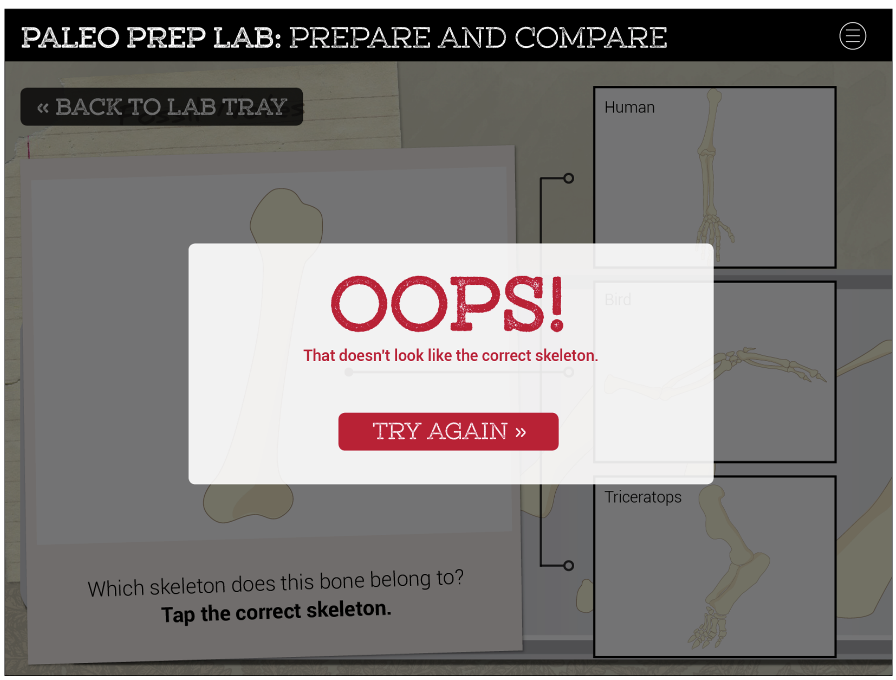


**Figure 86. Users will be alerted that their selection was wrong. The "Try Again" button will take them back to Figure 86. From there, when they make the correct selection, the screen moves to Figure 87.**

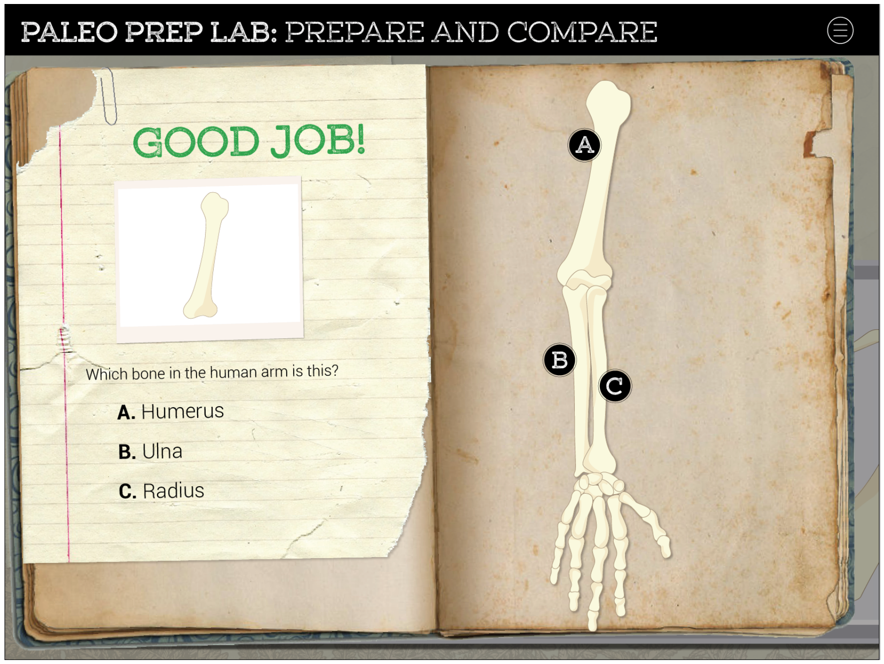


**Figure 87. The screen will show the skeleton it belongs to but will then ask users to identify which arm bone it is (*humerus, ulna or radius).* If the selection is incorrect, the screen moves to Figure 88. If the selection is correct, the screen moves to Figure 89.**

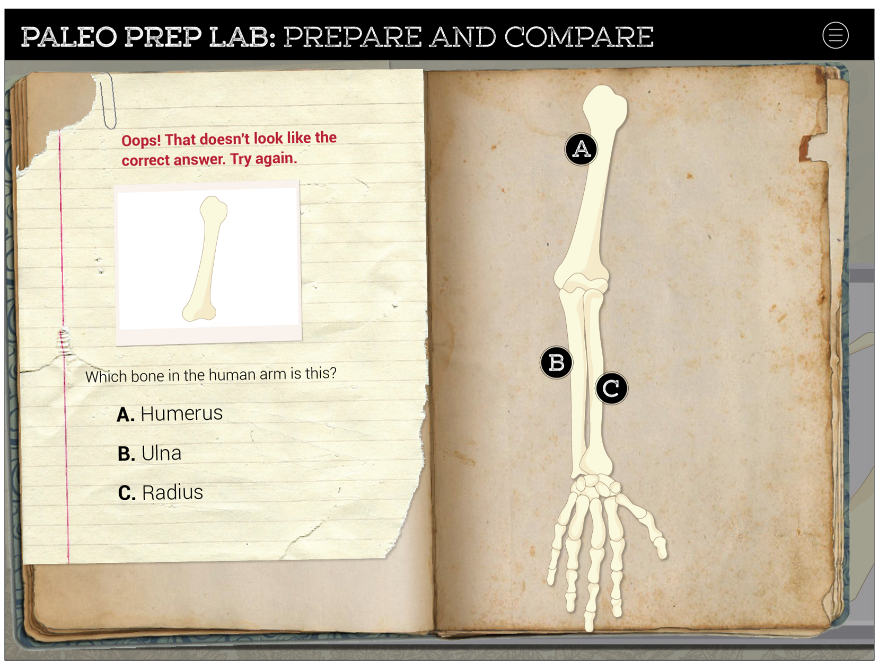


**Figure 88. Once the correct answer is selected, the screen moves to Figure 89.**

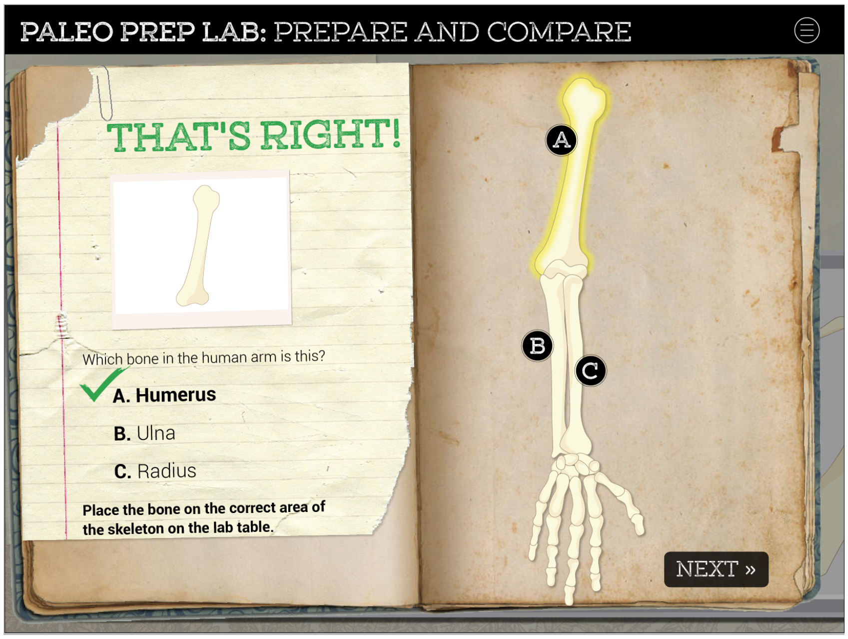


**Figure 89. The correct fossil is highlighted on the skeleton along with positive feedback and directions to place the physical fossil on the correct area of the skeleton outline on the lab table. The "Next" button moves the screen back to view all bones on the lab tray (Figure 90).**

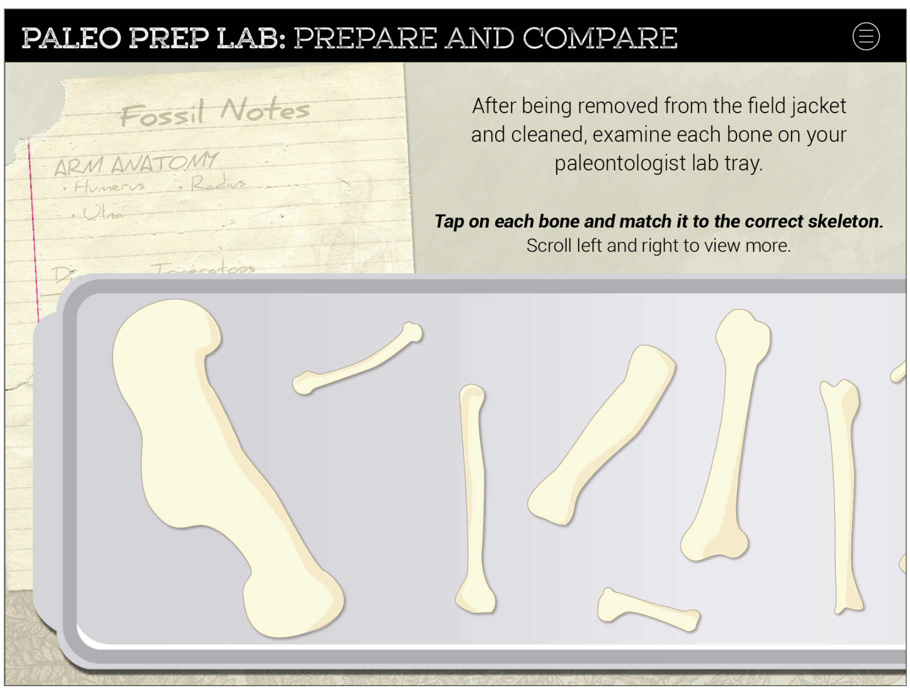


**Figure 90. Once users remove another fossil from its field jacket, they will find the fossil on the lab tray on the screen. The lab tray scrolls left and right to allow more viewing. By tapping the next fossil, the screen moves to Figure 91.**

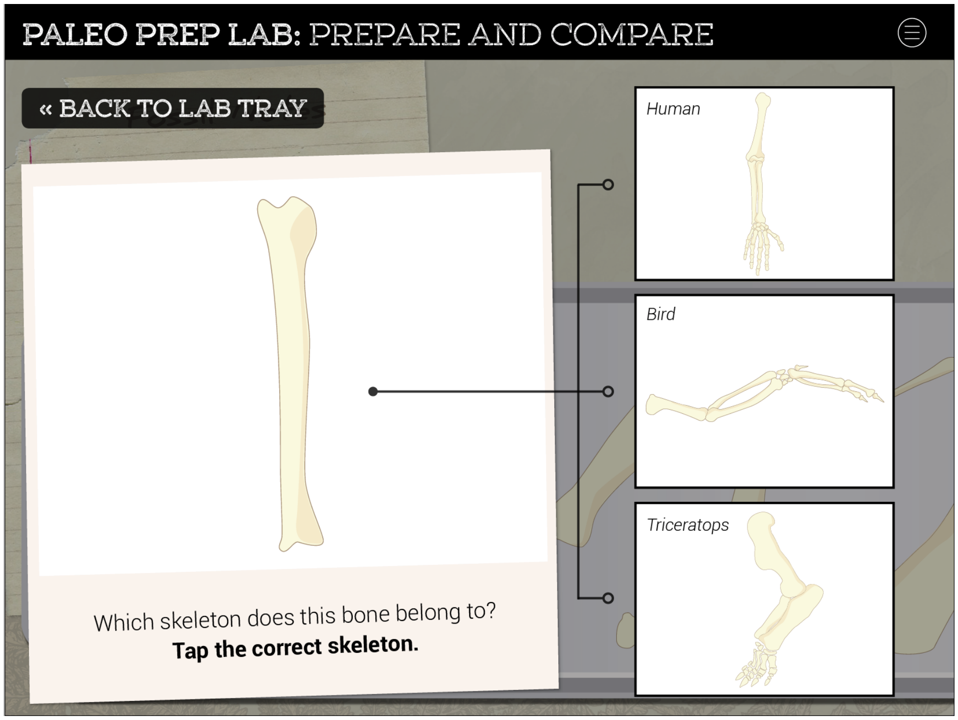


**Figure 91. The screen shows the enlarged bone and prompts users to tap the skeleton the bone belongs to (*Human, bird or Triceratops)*. If the selection is incorrect, the screen moves to Figure 92. If the selection is correct, the screen moves to Figure 93.**

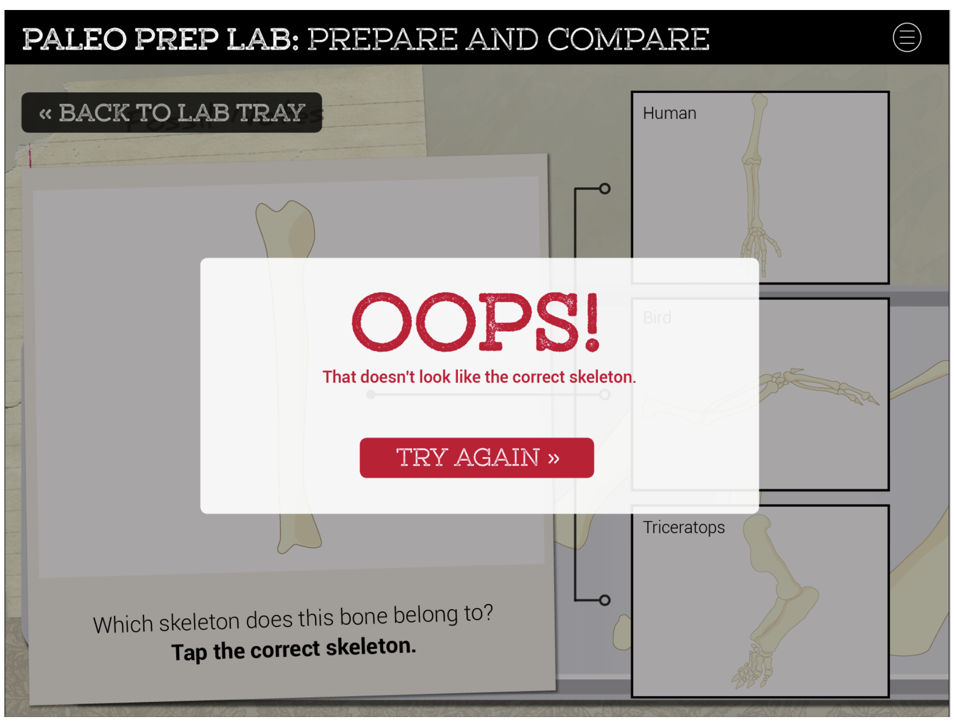


**Figure 92. Users will be alerted that their selection was wrong. The "Try Again" button will take them back to Figure 91. From there, when they make the correct selection, the screen moves to Figure 93.**

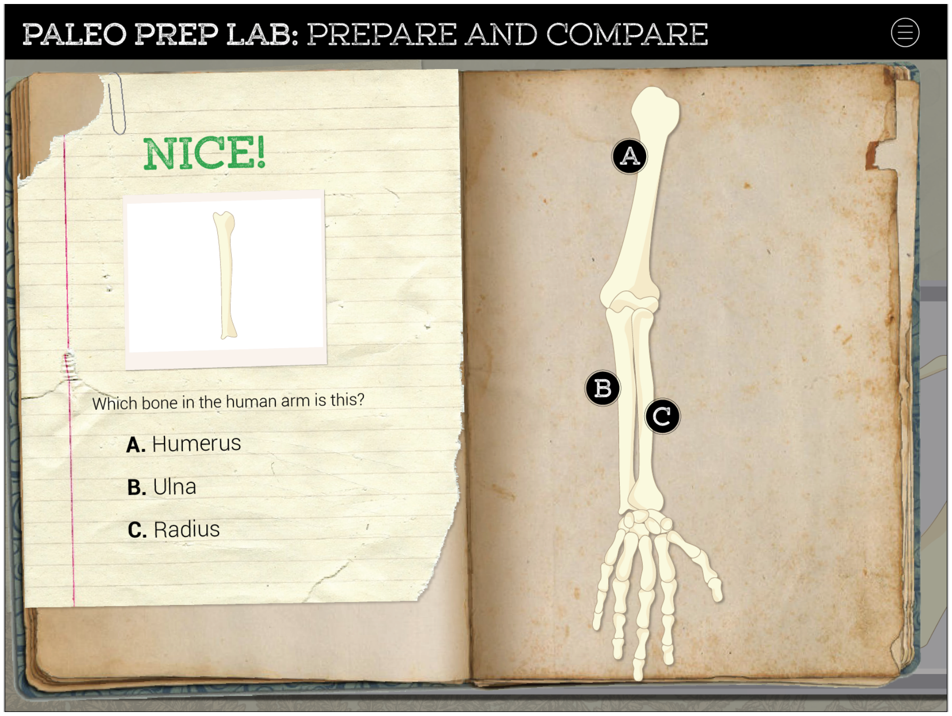


**Figure 93. The screen shows the skeleton it belongs to but will then ask the participant to identify which arm bone it is (*humerus, ulna or radius*). If the selection is incorrect, the screen moves to Figure 94. If the selection is correct, the screen moves to Figure 95.**

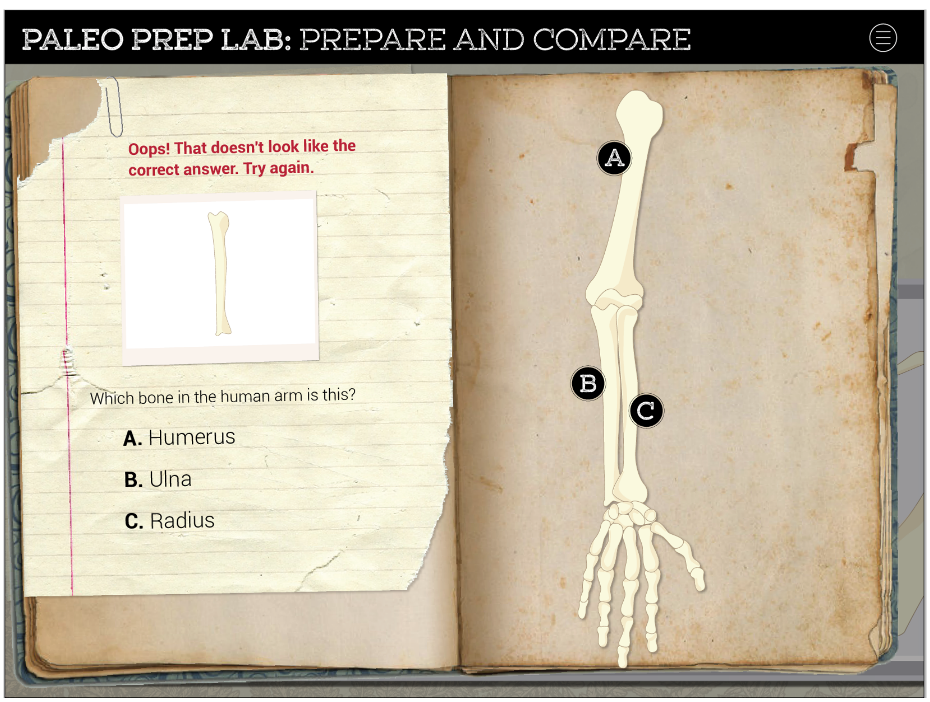


**Figure 94. Once the correct answer is selected, the screen moves to Figure 95.**

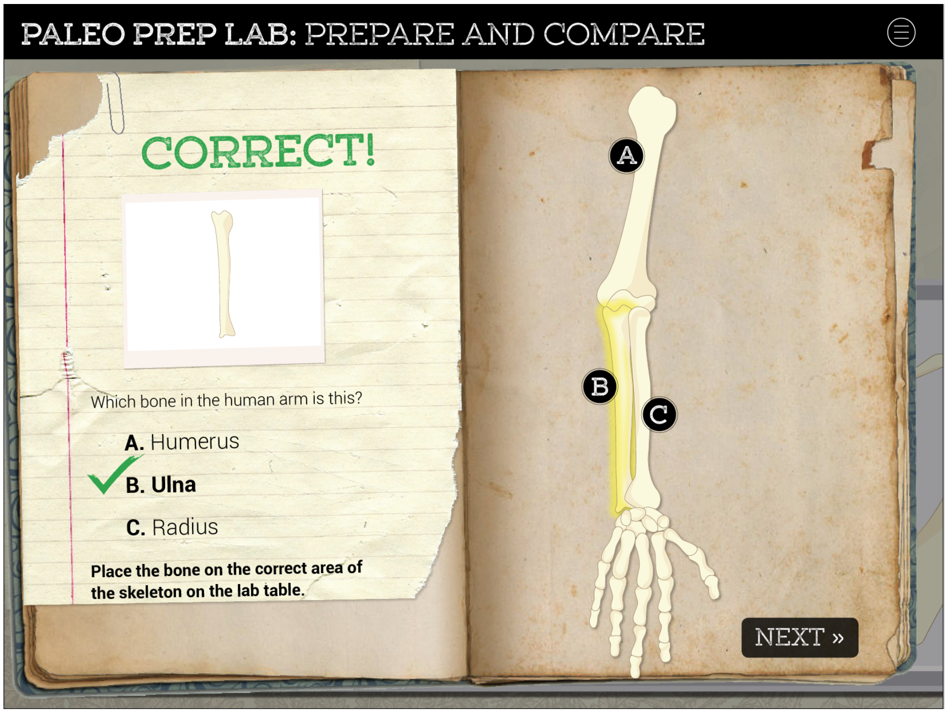


**Figure 95. The correct bone is highlighted on the skeleton along with positive feedback and directions to place the physical bone on the correct area of the skeleton outline on the lab table. The "Next" button moves the screen back to view all bones on the lab tray (Figure 96).**

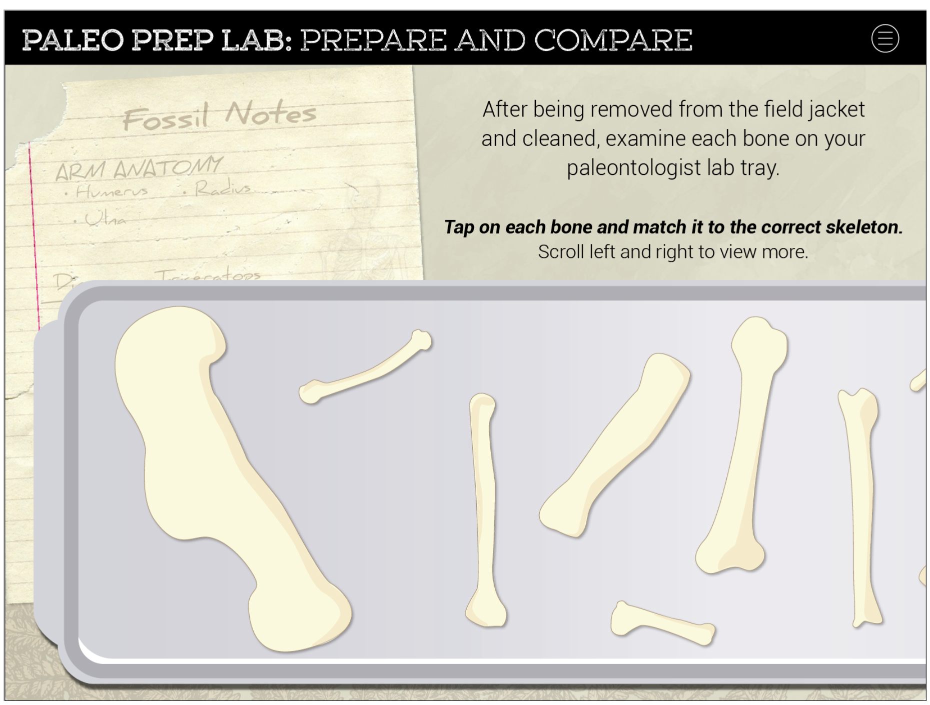


**Figure 96. Once users remove another fossil from its field jacket, they will find the fossil on the lab tray on the screen. The lab tray scrolls left and right to allow more viewing. By tapping the next fossil, the screen moves to Figure 97.**

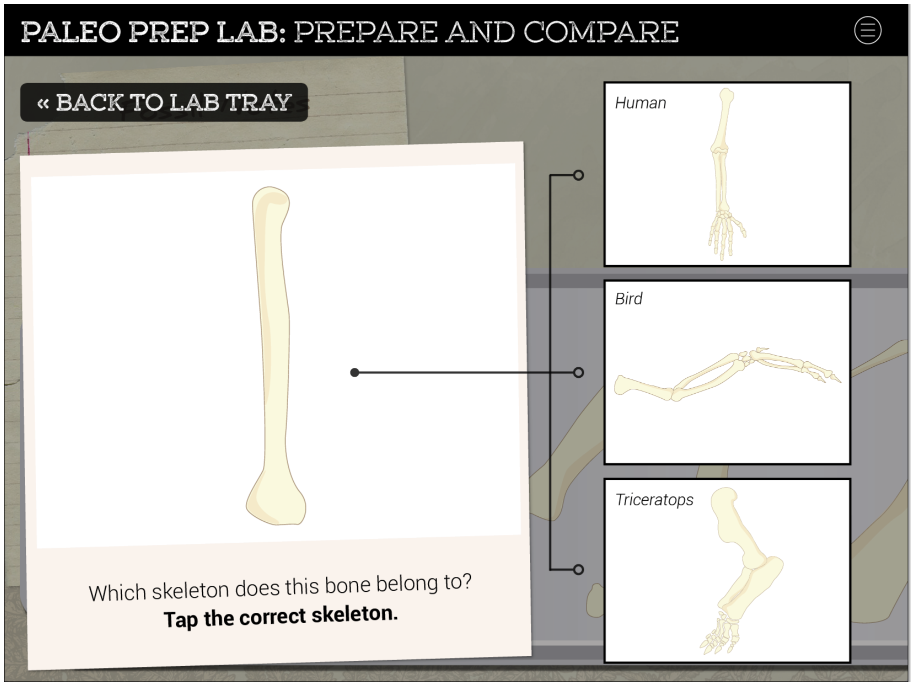


**Figure 97. The screen shows the enlarged bone and prompts users to tap the skeleton the bone belongs to (*Human, bird or Triceratops*). If the selection is incorrect, the screen moves to Figure 98. If the selection is correct, the screen moves to Figure 99.**

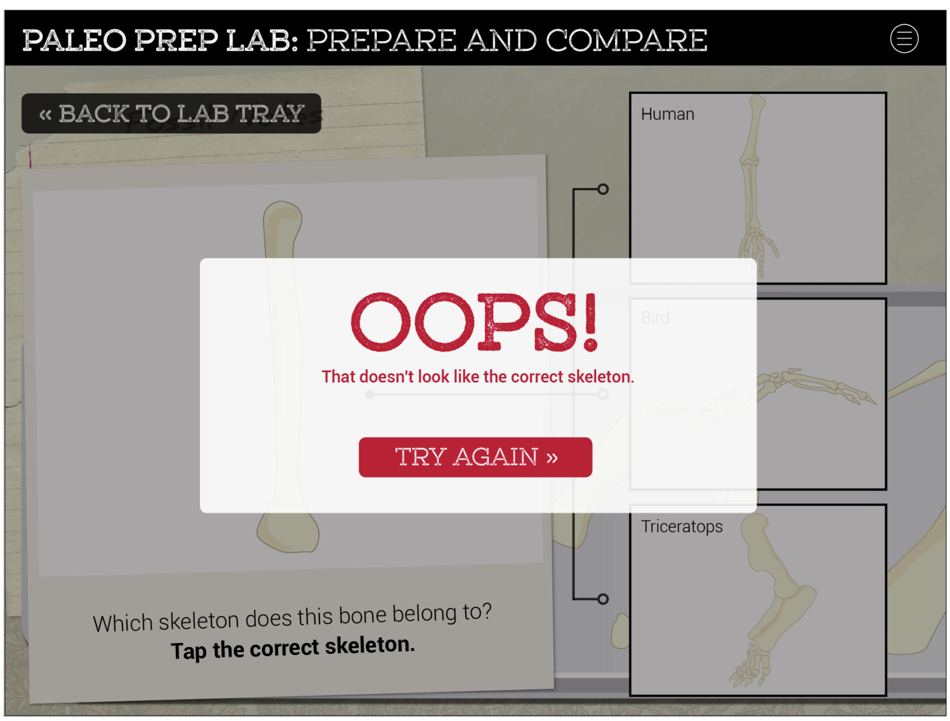


**Figure 98. Users will be alerted that their selection was wrong. The "Try Again" button will take them back to Figure 95. From there, when they make the correct selection, the screen moves to Figure 99.**

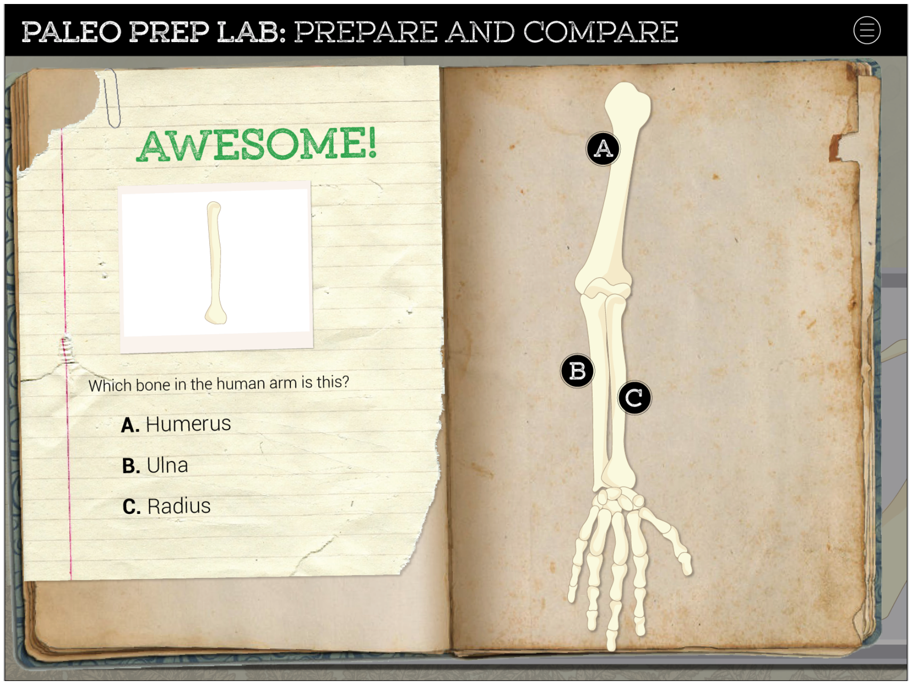


**Figure 99. The screen shows the skeleton it belongs to but will then ask users to identify which arm bone it is (*humerus, ulna or radius).* If the selection is incorrect, the screen moves to Figure 100. If the selection is correct, the screen moves to Figure 101.**

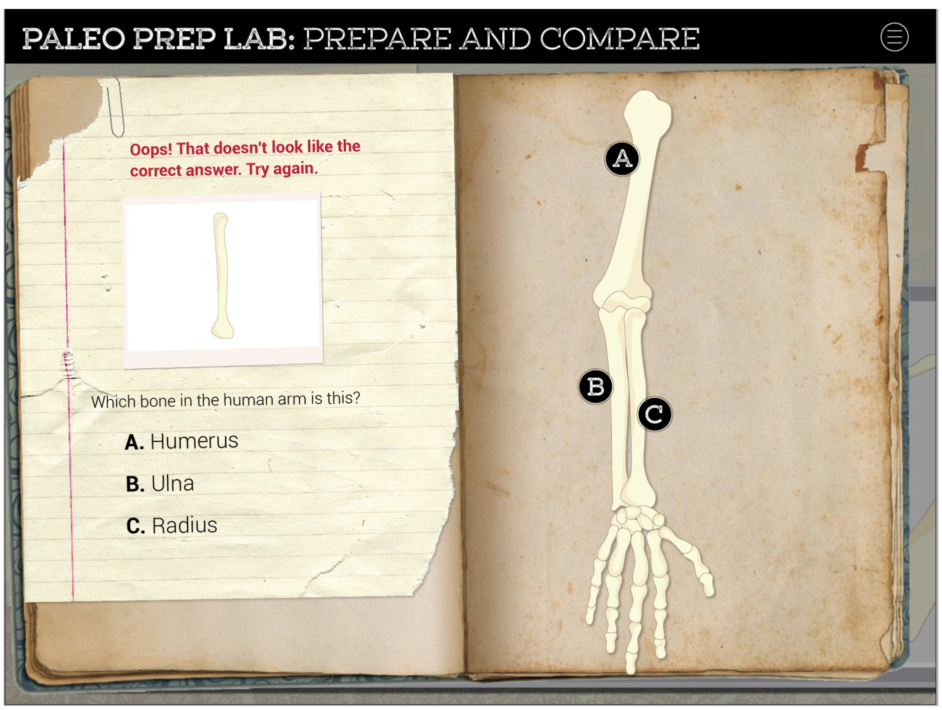


**Figure 100. Once the correct answer is selected, the screen moves to Figure 101.**

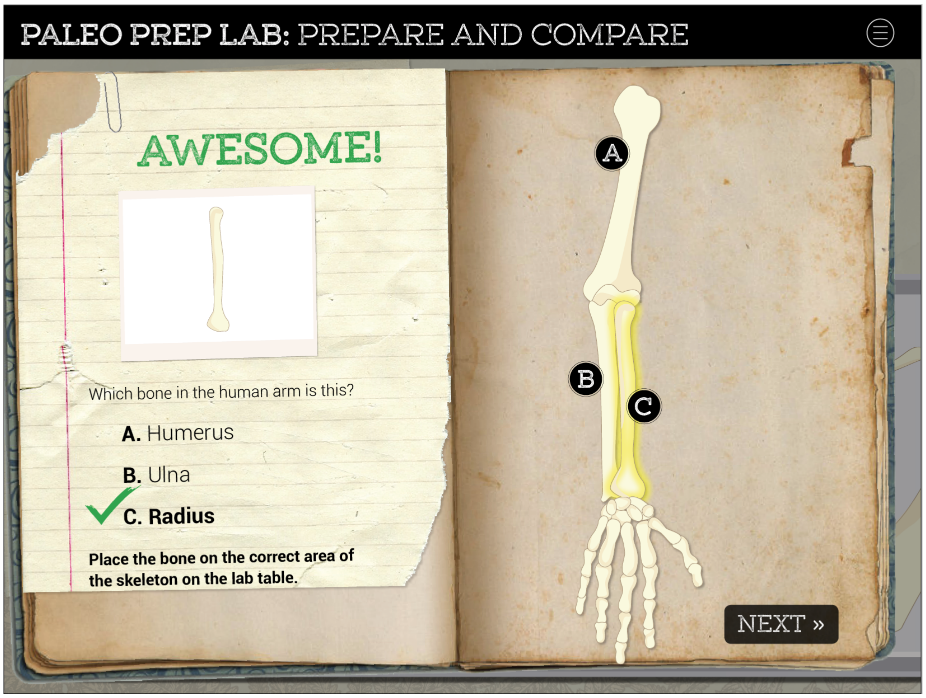


**Figure 101. The correct fossil is highlighted on the skeleton along with positive feedback and directions to place the physical fossil on the correct area of the skeleton outline on the lab table. The "Next" button moves the screen back to view all bones on the lab tray (Figure 102).**

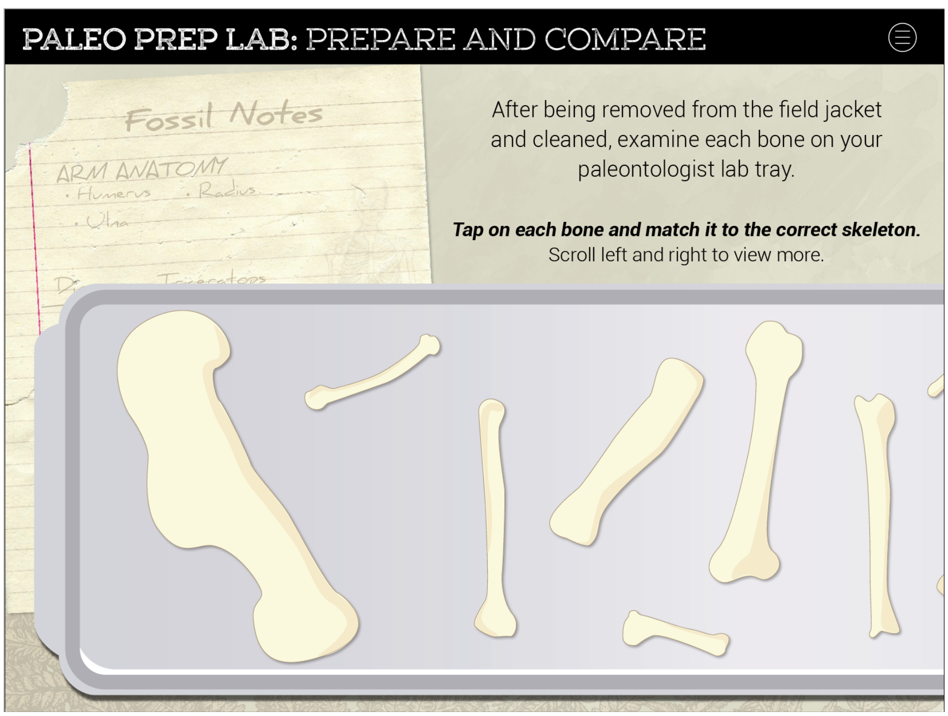


**Figure 102. Once users remove another fossil from its field jacket, they will find the fossil on the lab tray on the screen. The lab tray scrolls left and right to allow more viewing. By tapping the next fossil, the screen moves to Figure 103.**

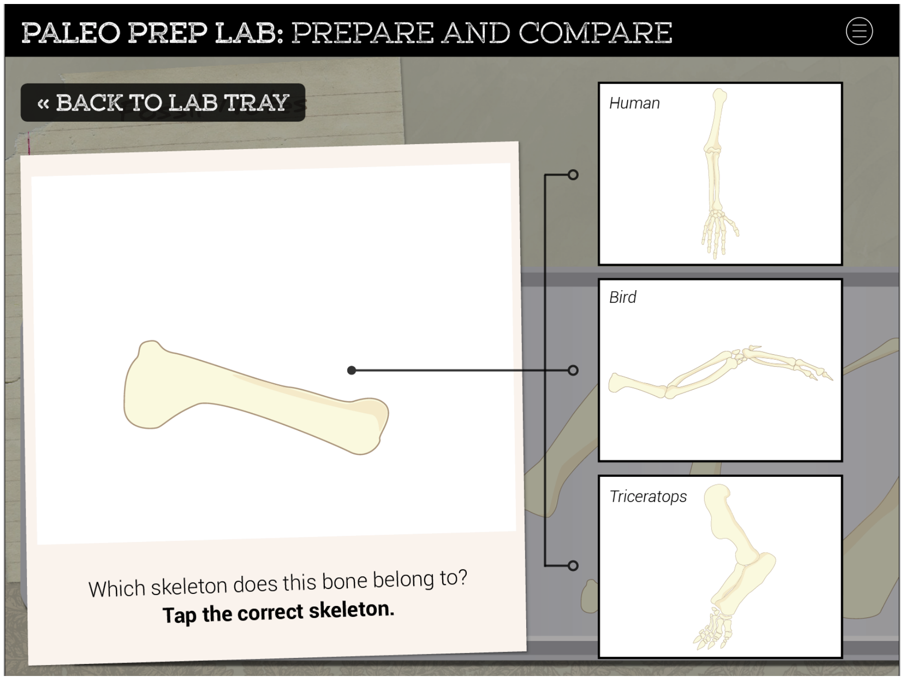


**Figure 103. The screen shows the enlarged bone and prompts users to tap the skeleton the bone belongs to (*Human, bird or Triceratops)*. If the selection is incorrect, the screen moves to Figure 104. If the selection is correct, the screen moves to Figure 105.**

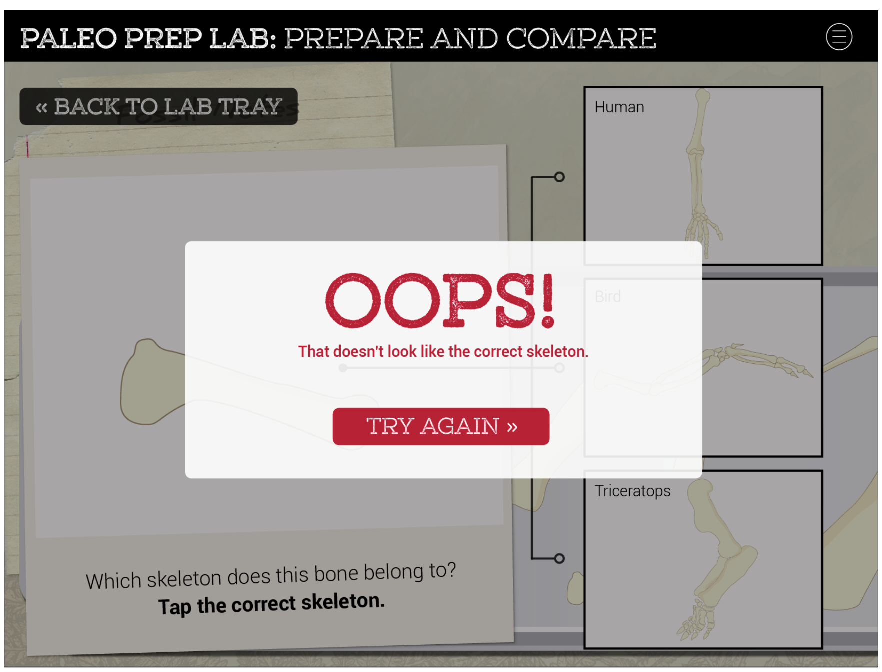


**Figure 104. Users will be alerted that their selection was wrong. The "Try Again" button will take them back to Figure 103. From there, when they make the correct selection, the screen moves to Figure 105.**

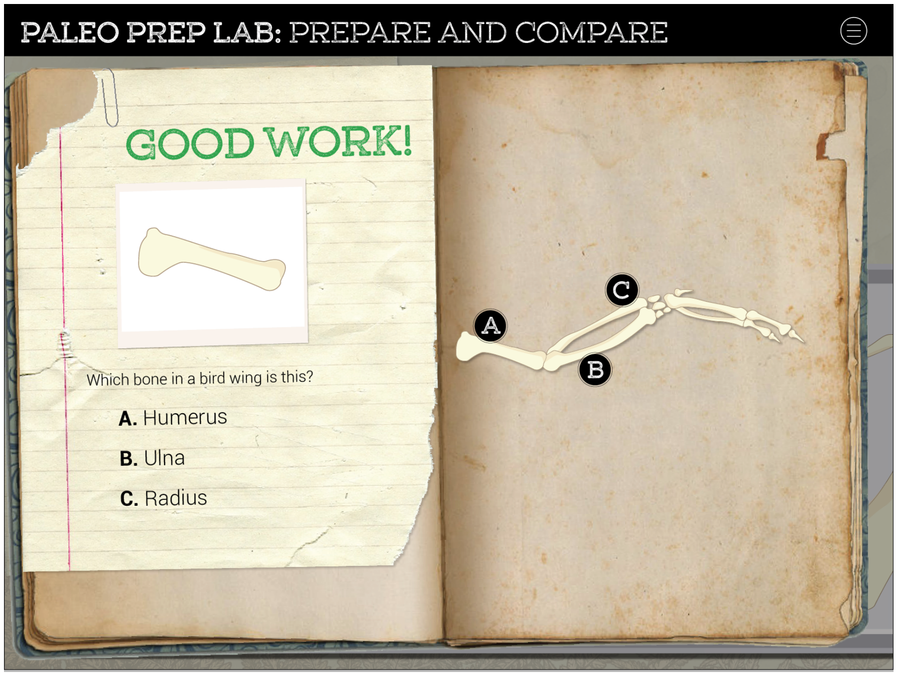


**Figure 105. The screen shows the skeleton it belongs to but will then ask the participant to identify which arm bone it is (*humerus, ulna or radius).* If the selection is incorrect, the screen moves to Figure 106. If the selection is correct, the screen moves to Figure 107.**

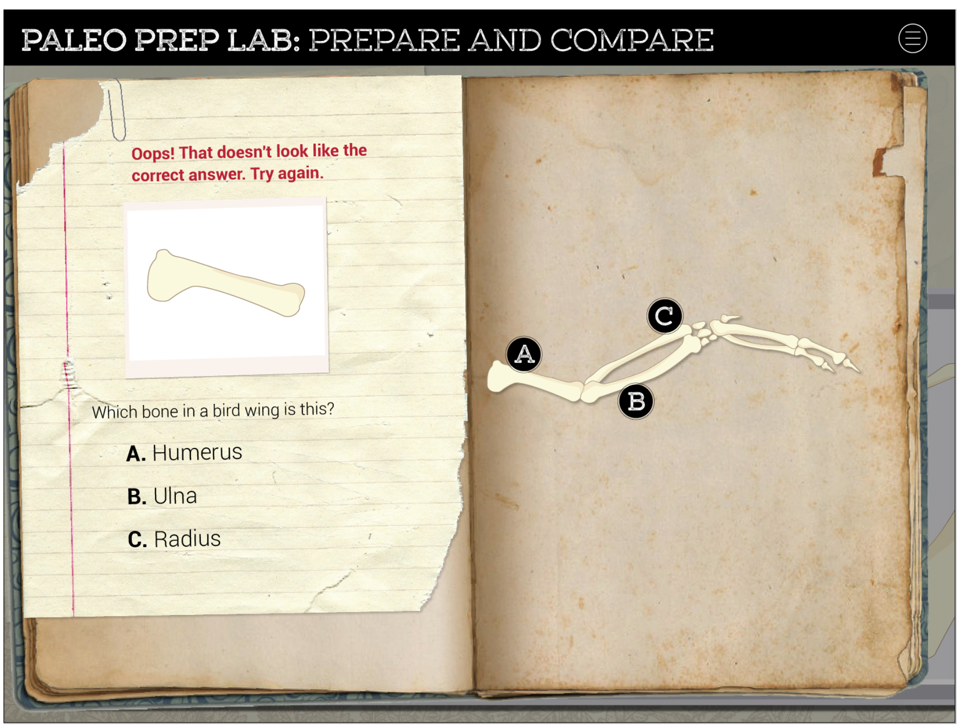


**Figure 106. Once the correct answer is selected, the screen moves to Figure 107.**

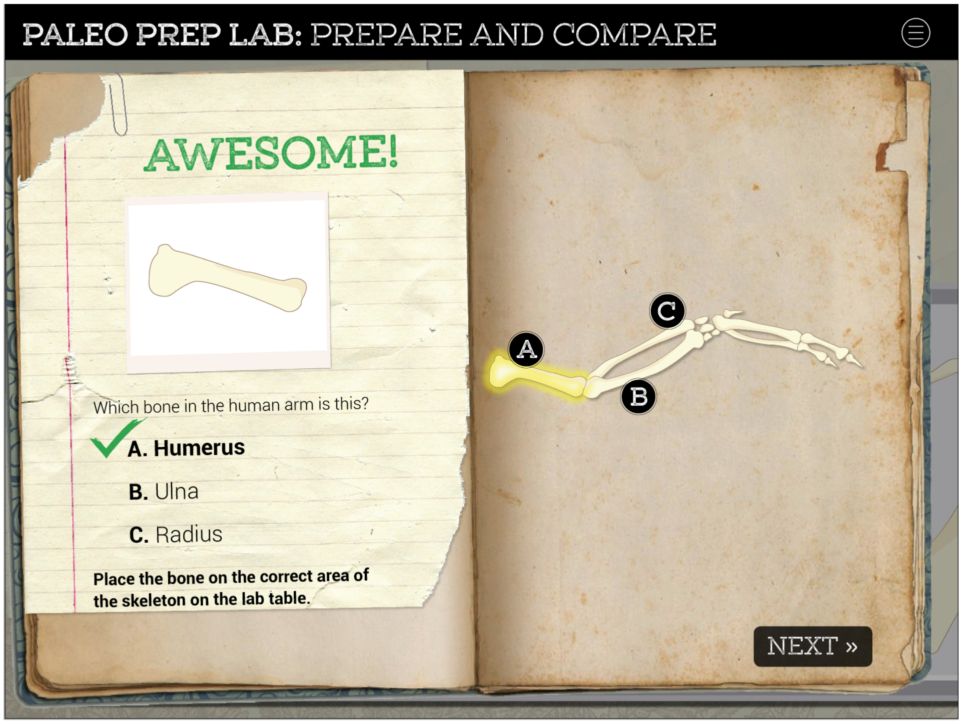


**Figure 107. The correct fossil is highlighted on the skeleton along with positive feedback and directions to place the physical fossil on the correct area of the skeleton outline on the lab table. The "Next" button moves the screen back to view all bones on the lab tray (Figure 108).**

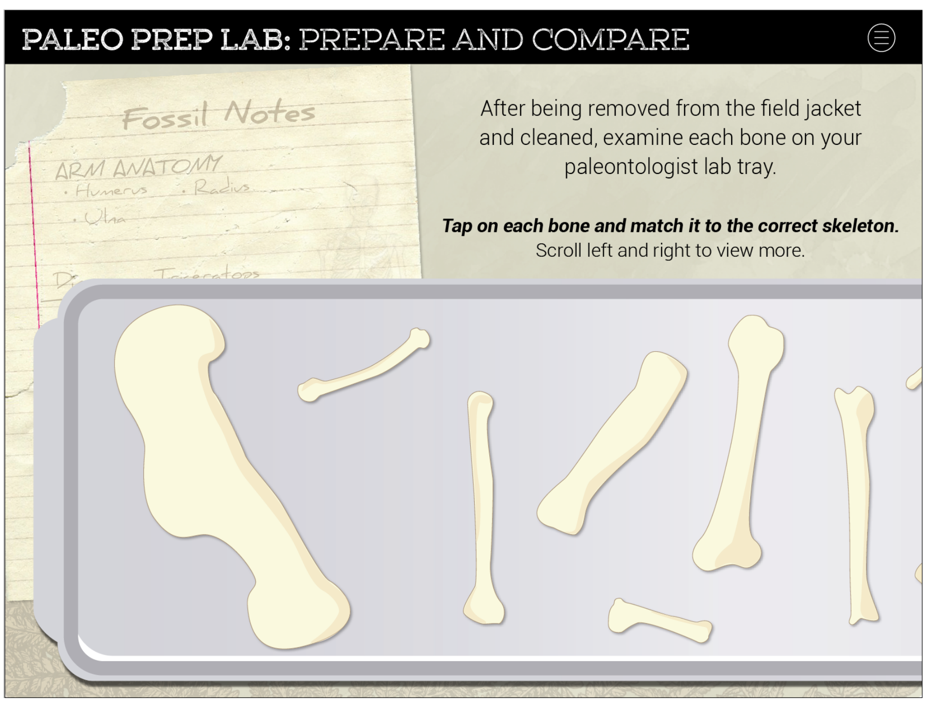


**Figure 108. Once users remove another fossil from its field jacket, they will find the fossil on the lab tray on the screen. The lab tray scrolls left and right to allow more viewing. By tapping the next fossil, the screen moves to Figure 109.**

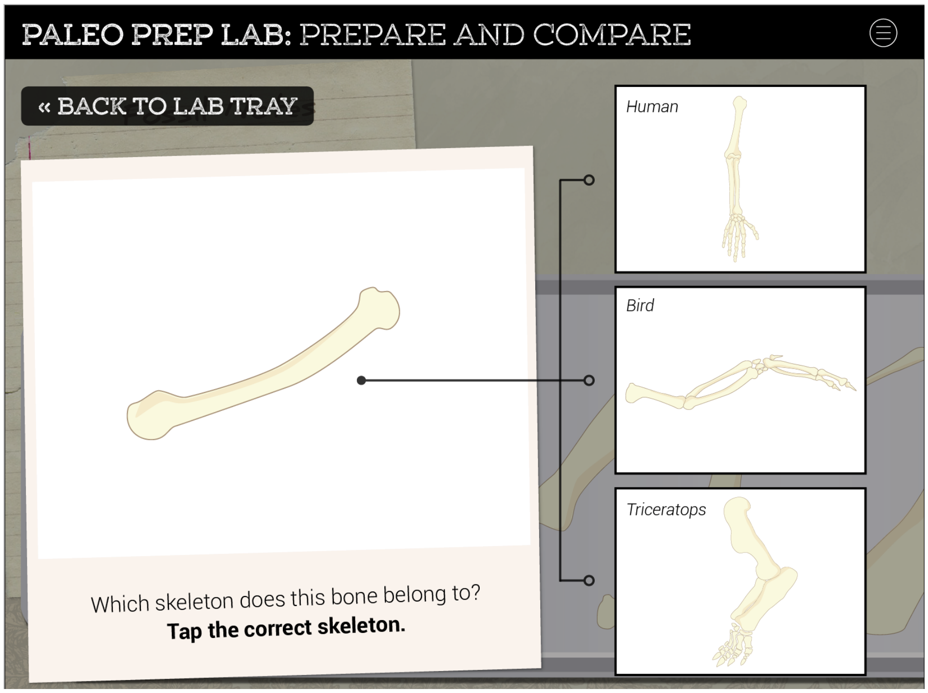


**Figure 109. The screen shows the enlarged bone and prompts users to tap the skeleton the bone belongs to (*Human, bird or Triceratops)*. If the selection is incorrect, the screen moves to Figure 110. If the selection is correct, the screen moves to Figure 111.**

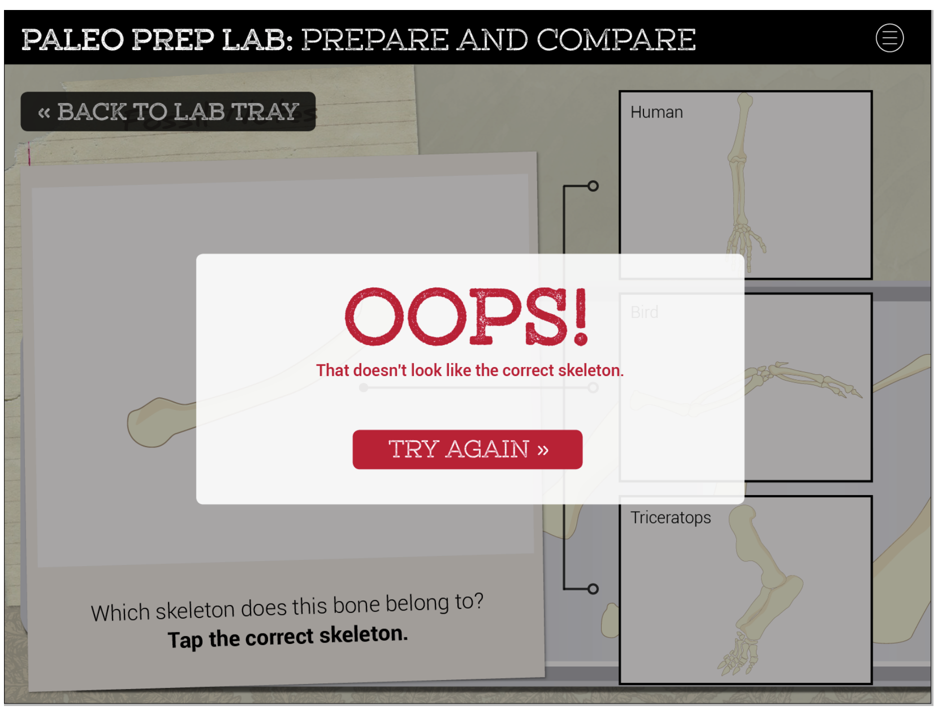


**Figure 110. Users will be alerted that their selection was wrong. The "Try Again" button will take them back to Figure 109. From there, when they make the correct selection, the screen moves to Figure 111.**

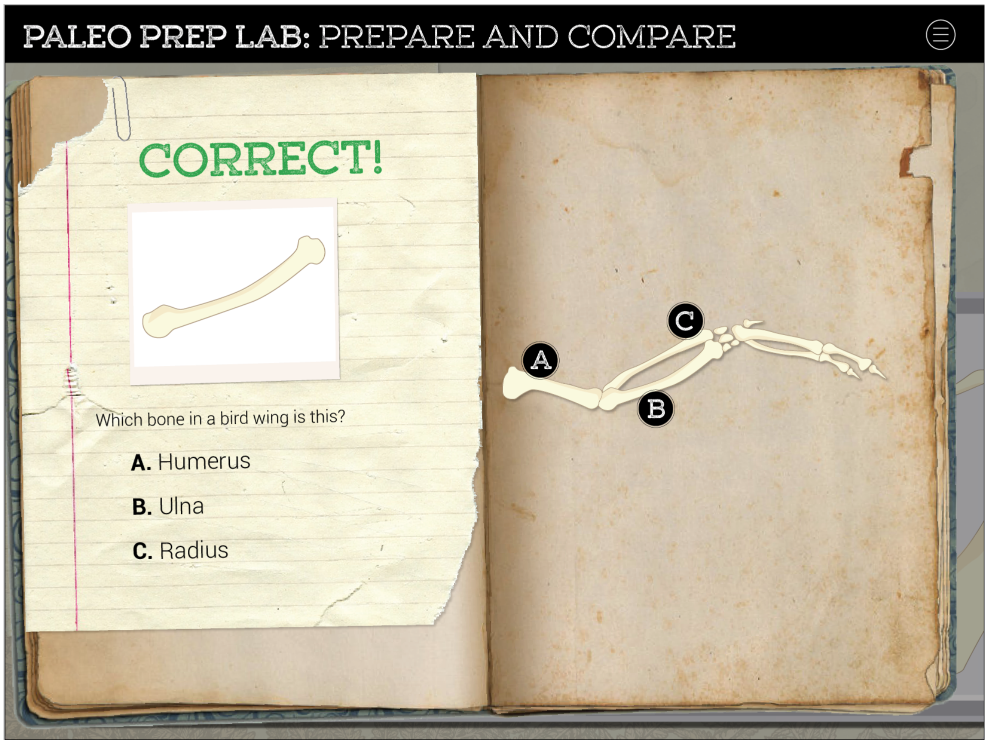


**Figure 111. The screen shows the skeleton it belongs to but will then ask the participant to identify which arm bone it is (*humerus, ulna or radius).* If the selection is incorrect, the screen moves to Figure 112. If the selection is correct, the screen moved to Figure 113.**

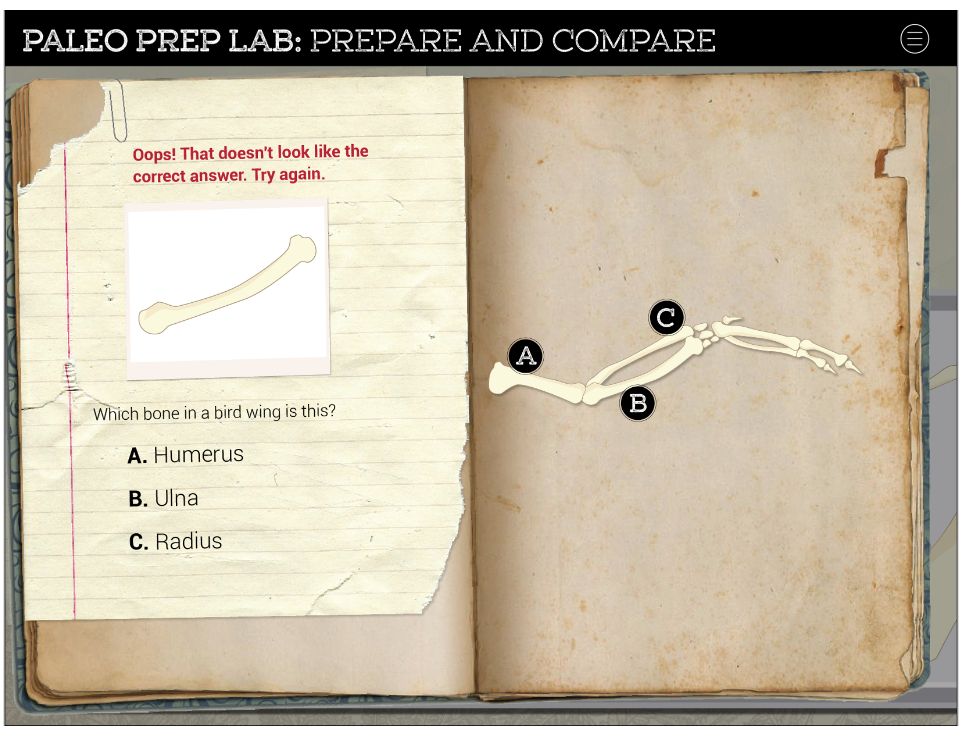


**Figure 112. Once the correct answer is selected, the screen moves to Figure 113.**

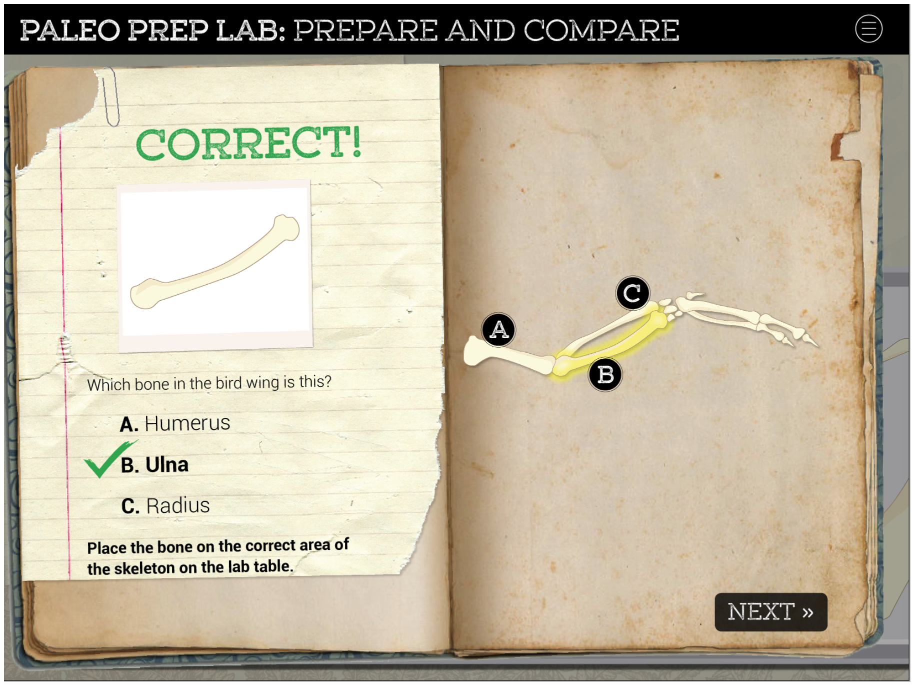


**Figure 113. The correct fossil is highlighted on the skeleton along with positive feedback and directions to place the physical fossil on the correct area of the skeleton outline on the lab table. The "Next" button moves the screen back to view all bones on the lab tray (Figure 114).**

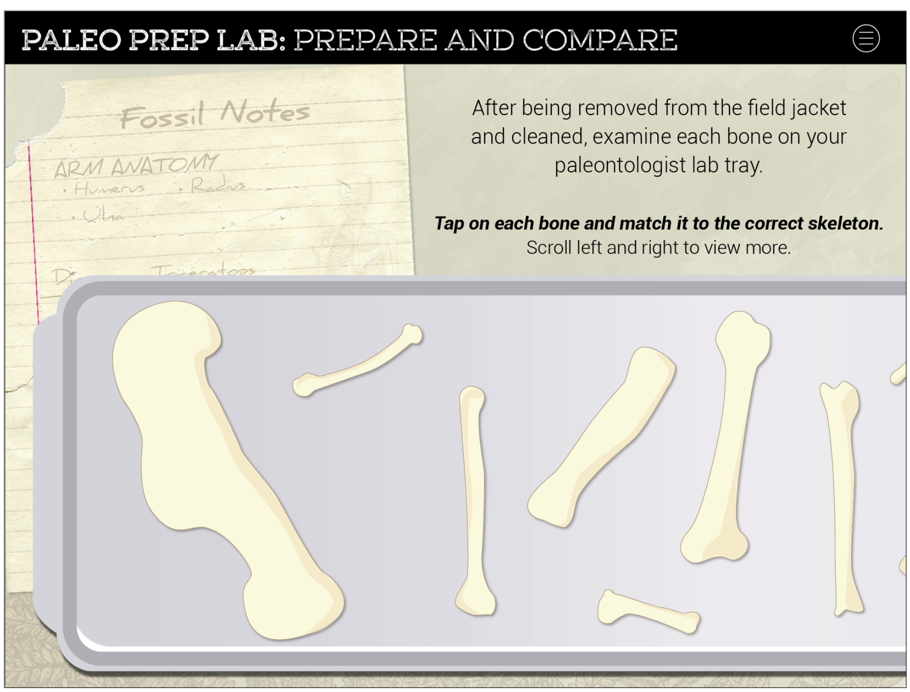


**Figure 114. Once users remove another fossil from its field jacket, they will find the fossil on the lab tray on the screen. The lab tray scrolls left and right to allow more viewing. By tapping the next fossil, the screen moves to Figure 115.**

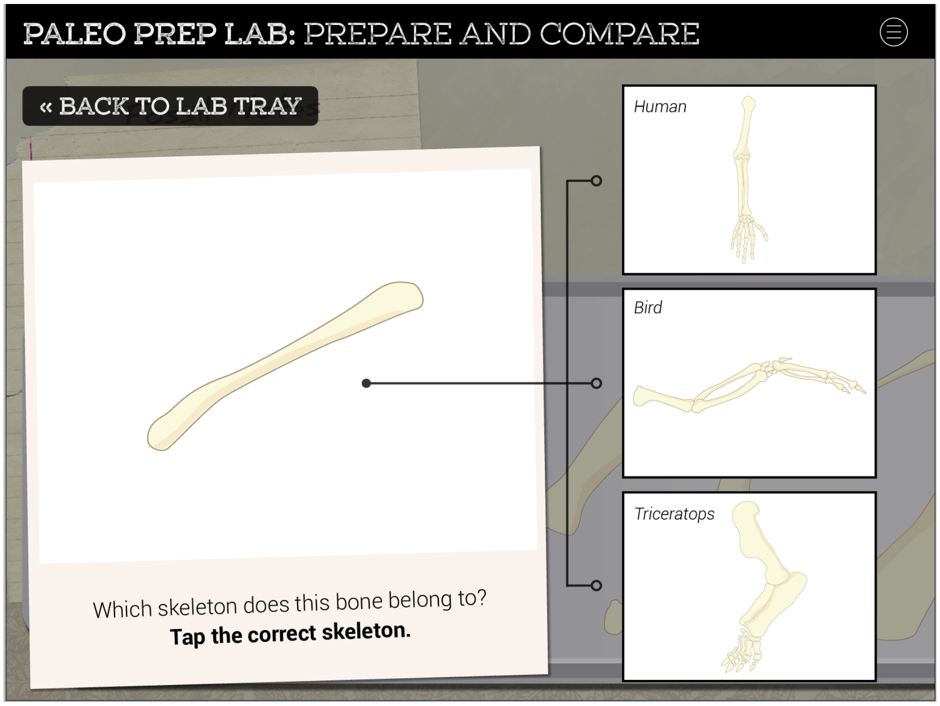


**Figure 115. The screen shows the enlarged bone and prompts users to tap the skeleton the bone belongs to (*Human, bird or Triceratops)*. If the selection is incorrect, the screen moves to Figure 116. If the selection is correct, the screen moves to Figure 117.**

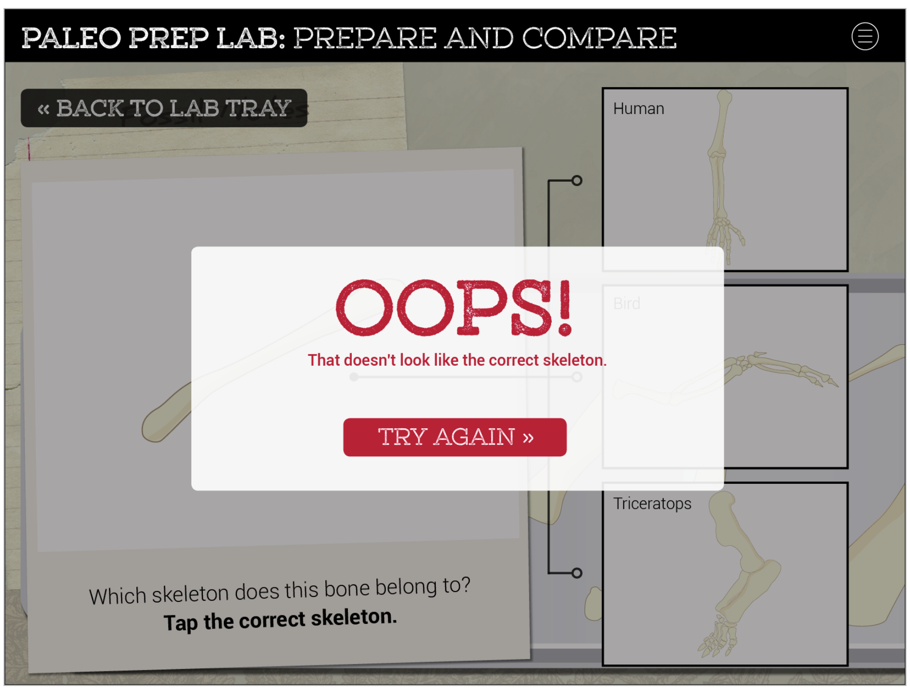


**Figure 116. Users will be alerted that their selection was wrong. The “Try Again” button will take them back to Figure 113. From there, when they make the correct selection, the screen moves to Figure 117.**

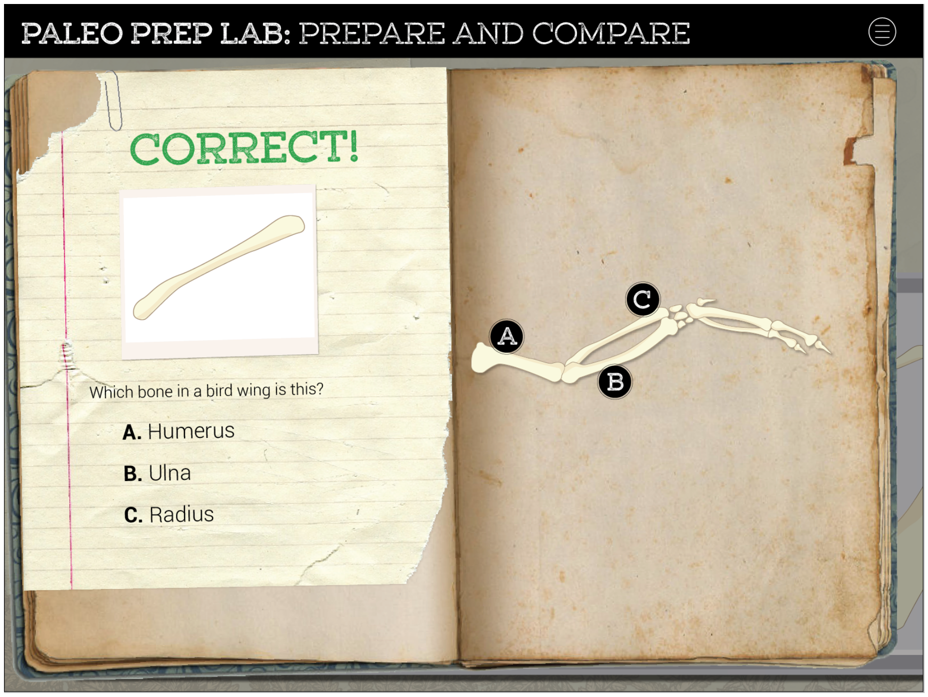


**Figure 117. The screen shows the skeleton it belongs to but will then ask the participant to identify which arm bone it is (*humerus, ulna or radius*). If the selection is incorrect, the screen moves to Figure 118. If the selection is correct, the screen moves to Figure 119.**

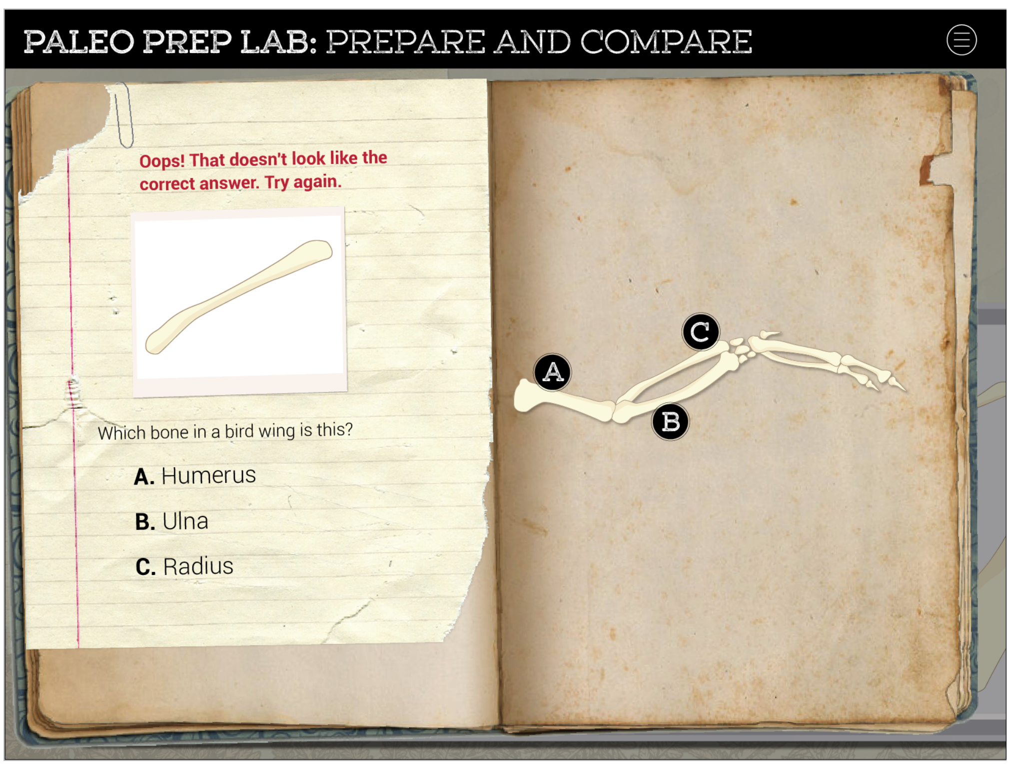


**Figure 118. Once the correct answer is selected, the screen moves to Figure 119.**

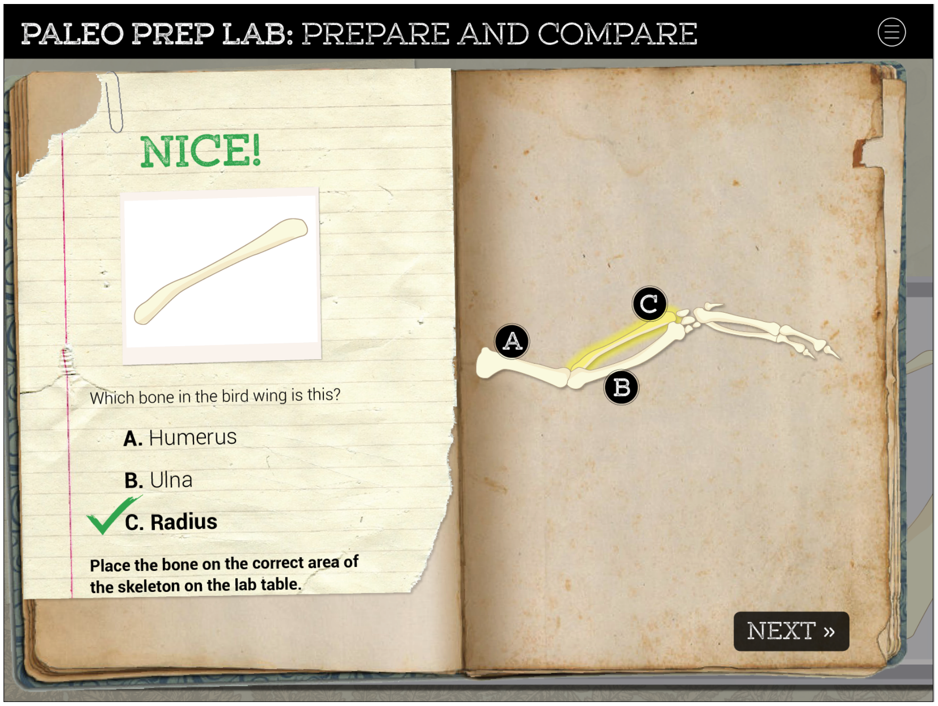


**Figure 119. The correct fossil is highlighted on the skeleton along with positive feedback and directions to place the physical fossil on the correct area of the skeleton outline on the lab table. The "Next" button moves the screen back to view all bones on the lab tray (Figure 120).**

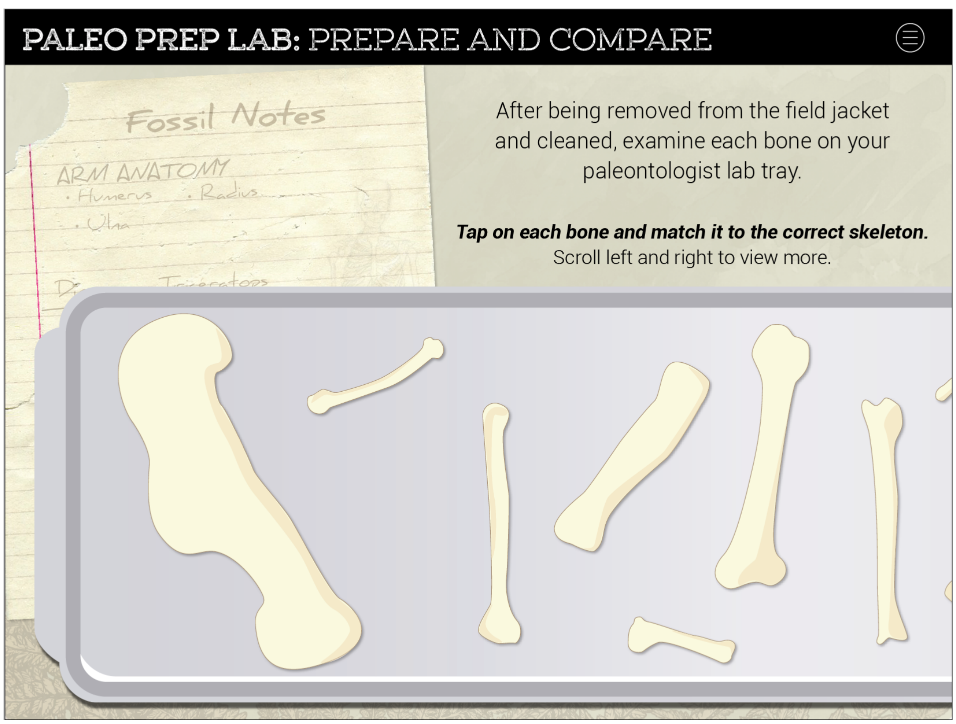


**Figure 120. Once users remove another fossil from its field jacket, they will find the fossil on the lab tray on the screen. The lab tray scrolls left and right to allow more viewing. By tapping the next fossil, the screen moves to Figure 121.**

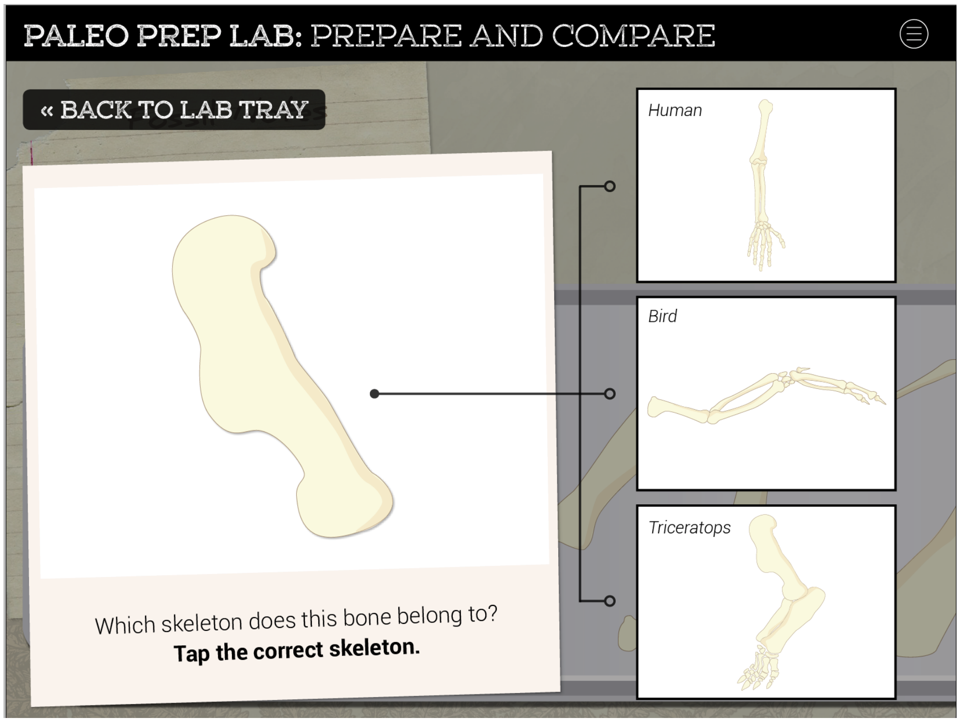


**Figure 121. The screen shows the enlarged bone and prompts users to tap the skeleton the bone belongs to (*Human, bird or Triceratops)*. If the selection is incorrect, the screen moves to Figure 122. If the selection is correct, the screen moves to Figure 123.**

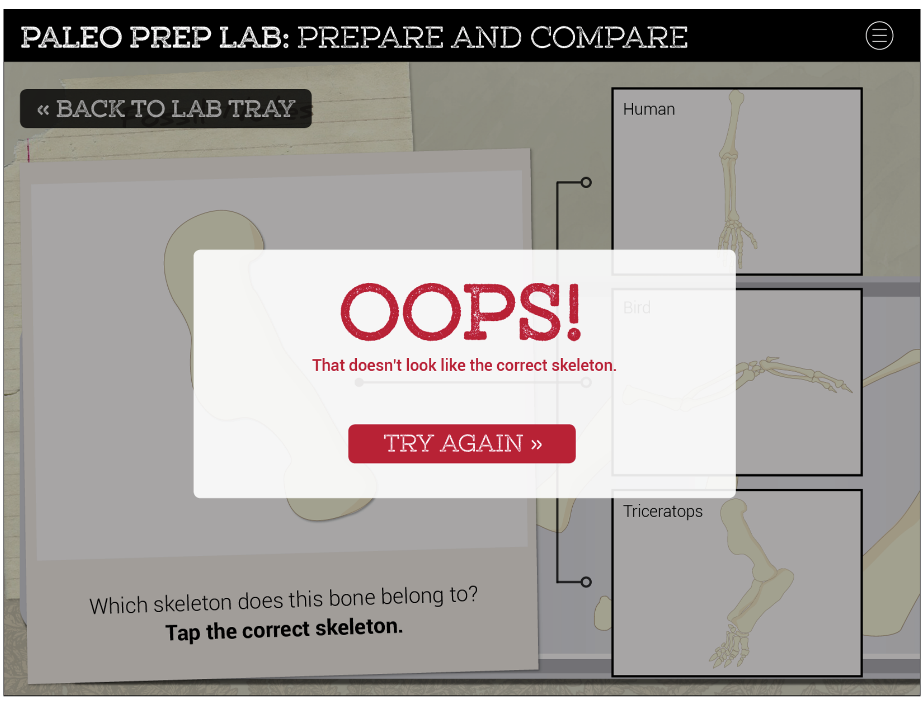


**Figure 122. Users will be alerted that their selection was wrong. The "Try Again" button will take them back to Figure 121. From there, when they make the correct selection, the screen moves to Figure 123.**

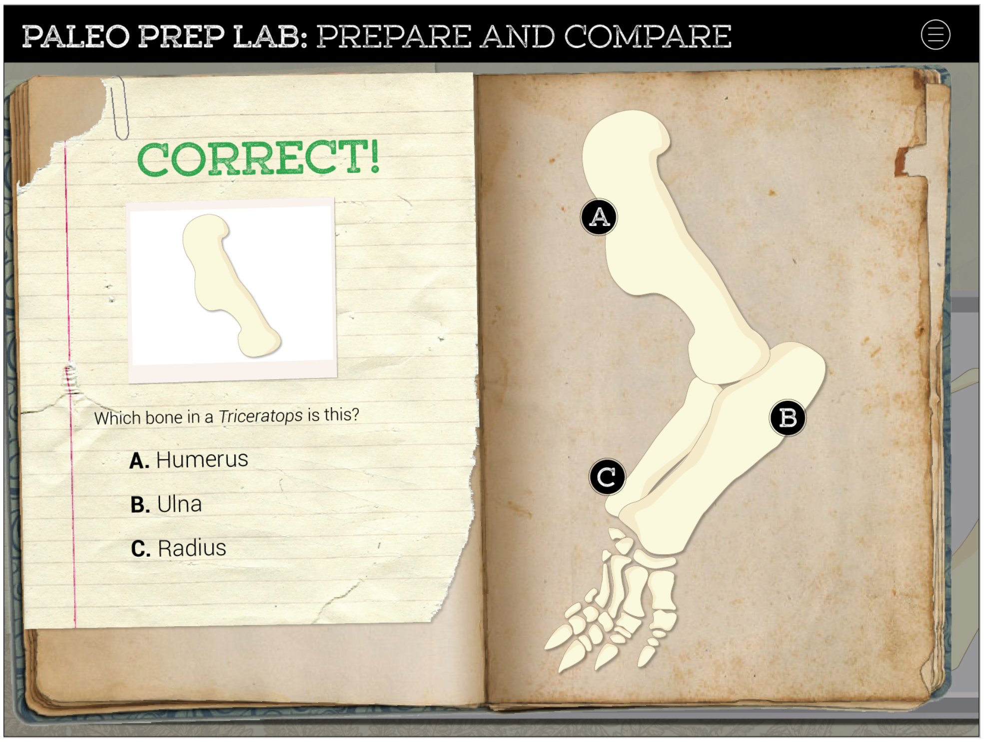


**Figure 123. The screen shows the skeleton it belongs to but will then prompts users to identify which arm bone it is (*humerus, ulna or radius).* If the selection is incorrect, the screen moves to Figure 124. If the selection is correct, the screen moves to Figure 125.**

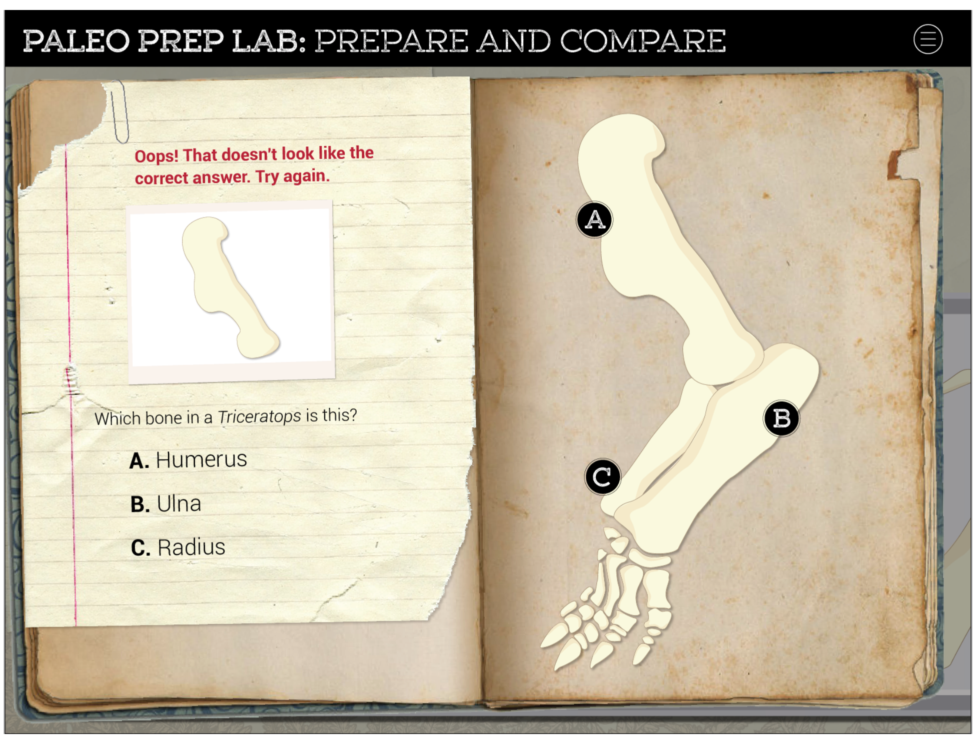


**Figure 124. Once the correct answer is selected, the screen moves to Figure 125.**

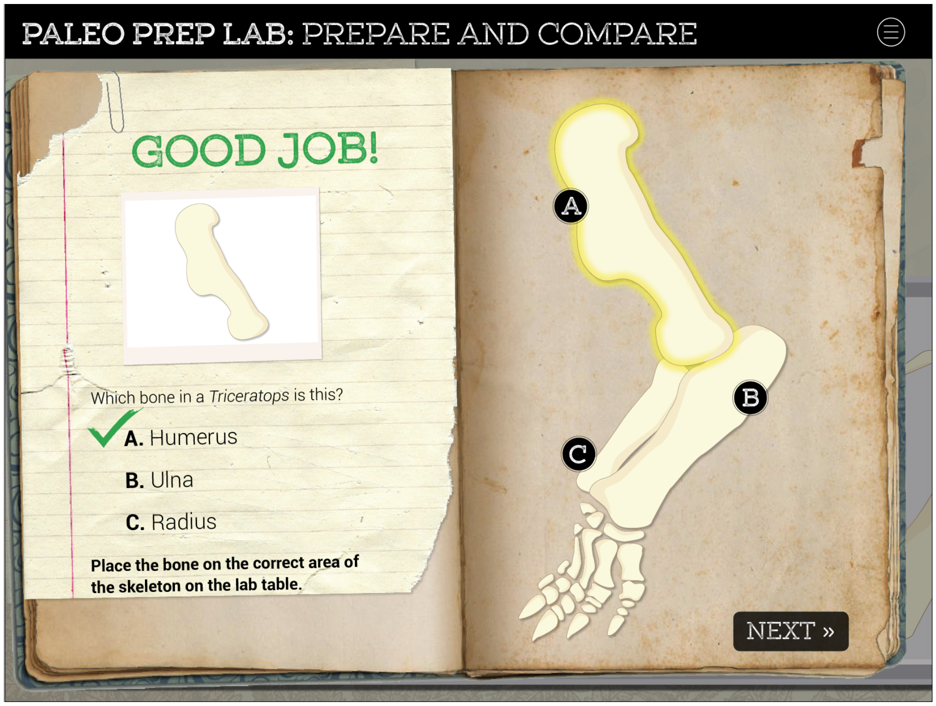


**Figure 125. The correct fossil is highlighted on the skeleton along with positive feedback and directions to place the physical fossil on the correct area of the skeleton outline on the lab table. The "Next" button moves the screen back to view all bones on the lab tray (Figure 126).**

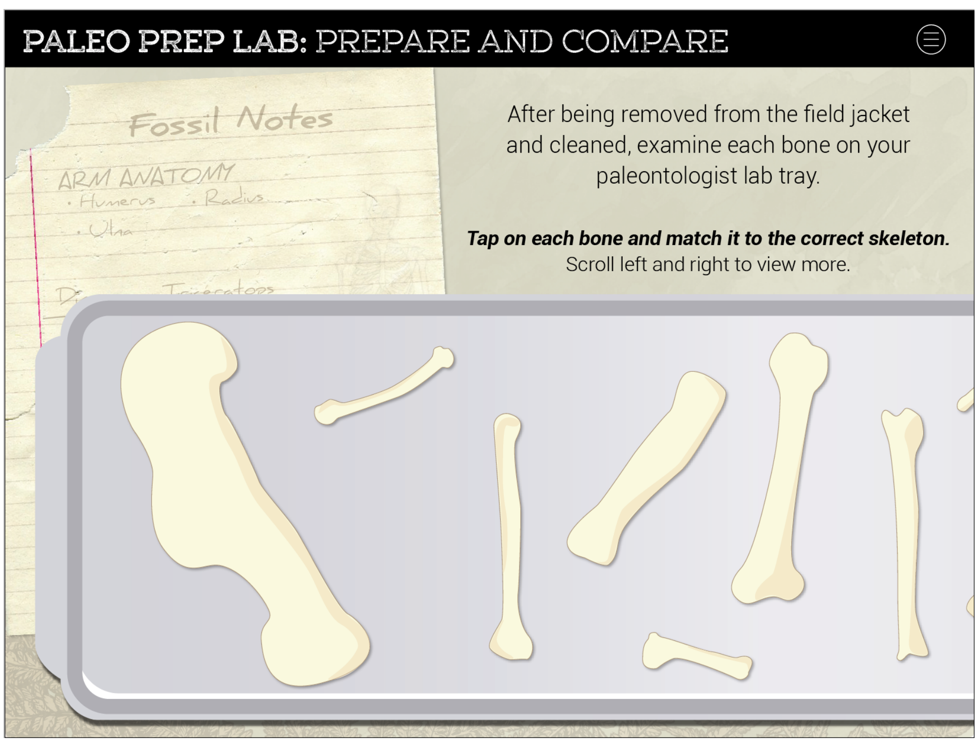


**Figure 126. Once users removes another fossil from its field jacket, they will find the fossil on the lab tray on the screen. The lab tray scrolls left and right to allow more viewing. By tapping the next fossil, the screen moves to Figure 127.**

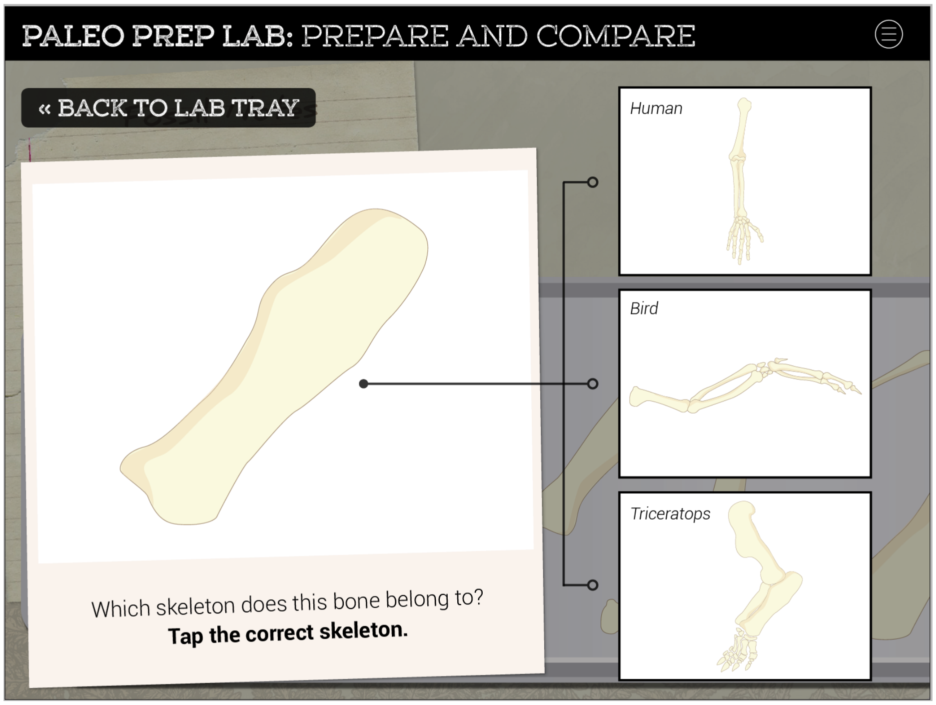


**Figure 127. The screen shows the enlarged bone and prompts users to tap the skeleton the bone belongs to (*Human, bird or Triceratops)*. If the selection is incorrect, the screen moves to Figure 128. If the selection is correct, the screen moves to Figure 129.**

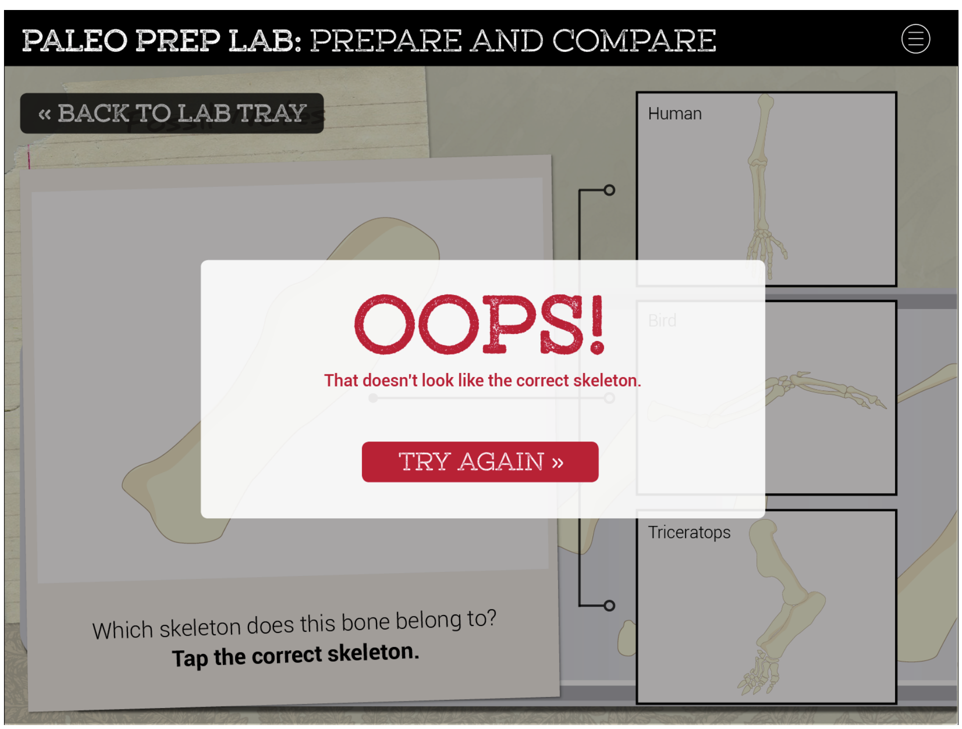


**Figure 128. Users will be alerted that their selection was wrong. The "Try Again" button will take them back to Figure 127. From there, when they make the correct selection, the screen moves to Figure 129.**

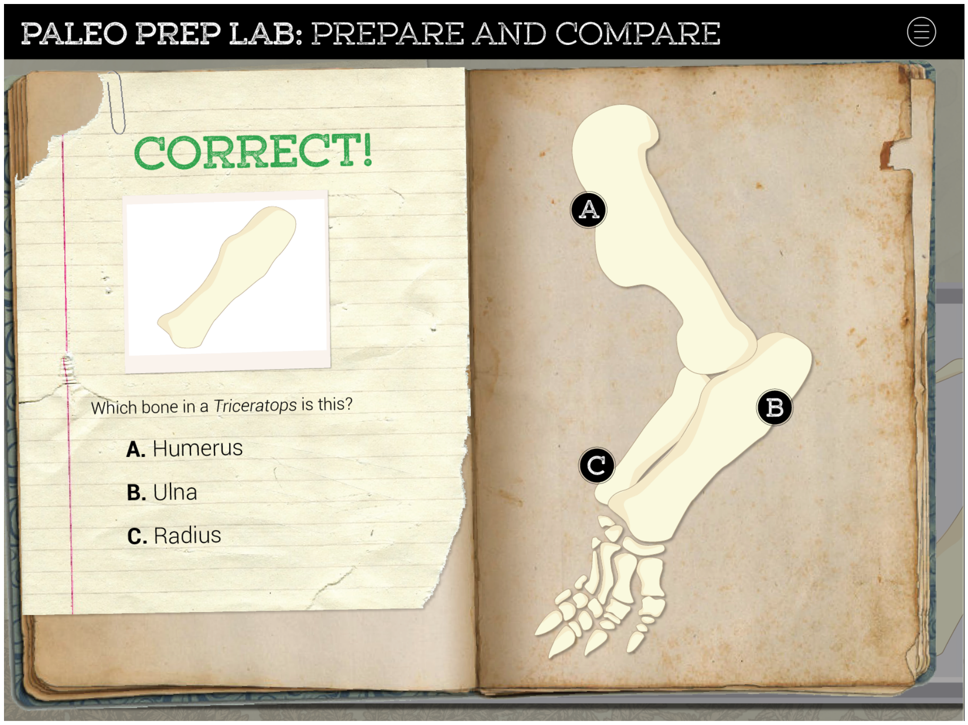


**Figure 129. The screen shows the skeleton it belongs to but will then prompts users to identify which arm bone it is (*humerus, ulna or radius*). If the selection is incorrect, the screen moves to Figure 128. If the selection is correct, the screen moves to Figure 130.**

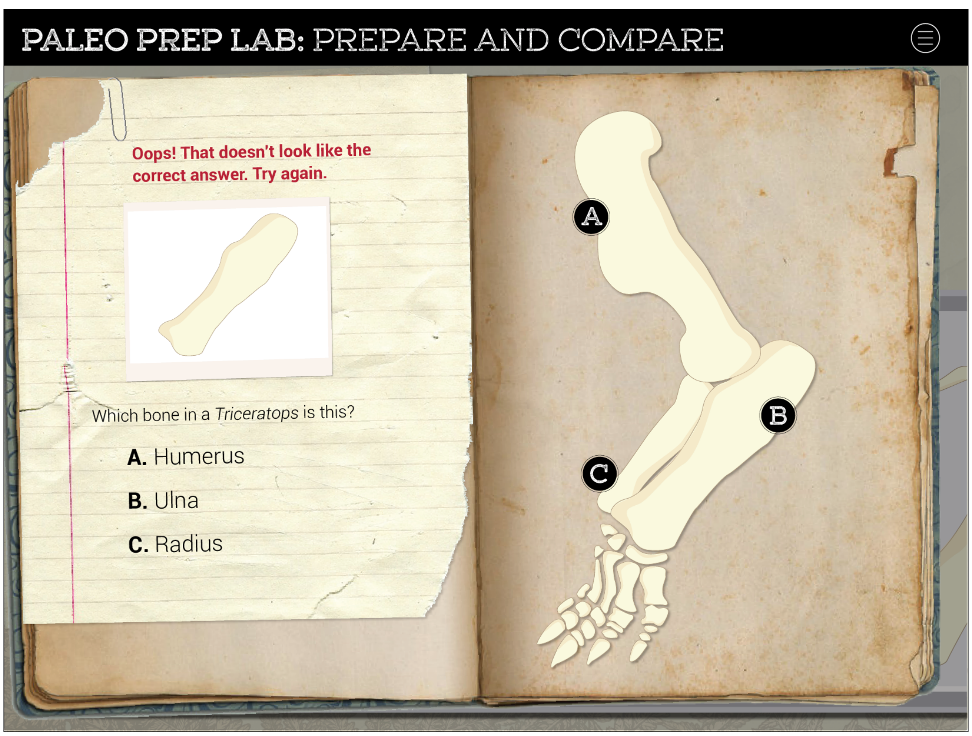


**Figure 130. Once the correct answer is selected, the screen moves to Figure 131.**

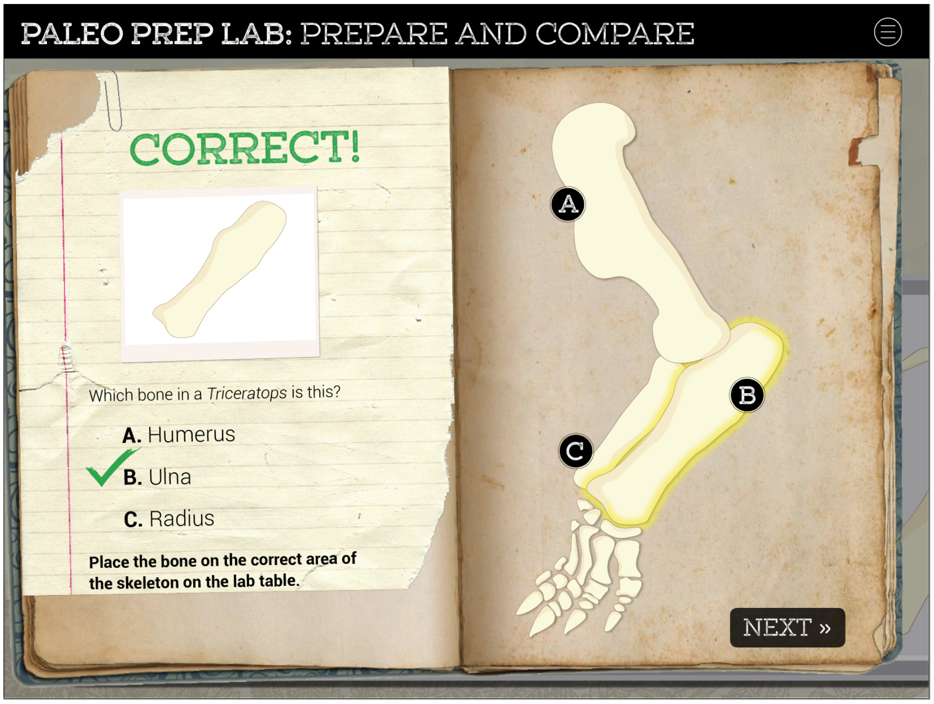


**Figure 131. The correct fossil is highlighted on the skeleton along with positive feedback and directions to place the physical fossil on the correct area of the skeleton outline on the lab table. The "Next" button moves the screen back to view all bones on the lab tray (Figure 132).**

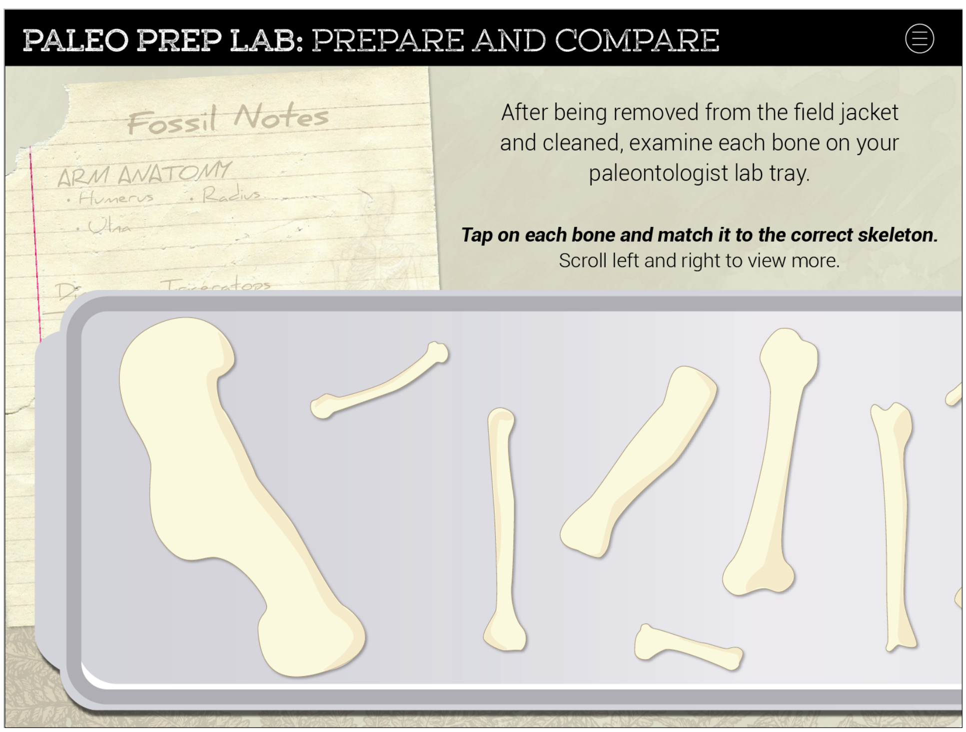


**Figure 132. Once users remove the last fossil from its field jacket, they will find the fossil on the lab tray on the screen. The lab tray scrolls left and right to allow more viewing. By tapping the last fossil, the screen moves to Figure 133.**

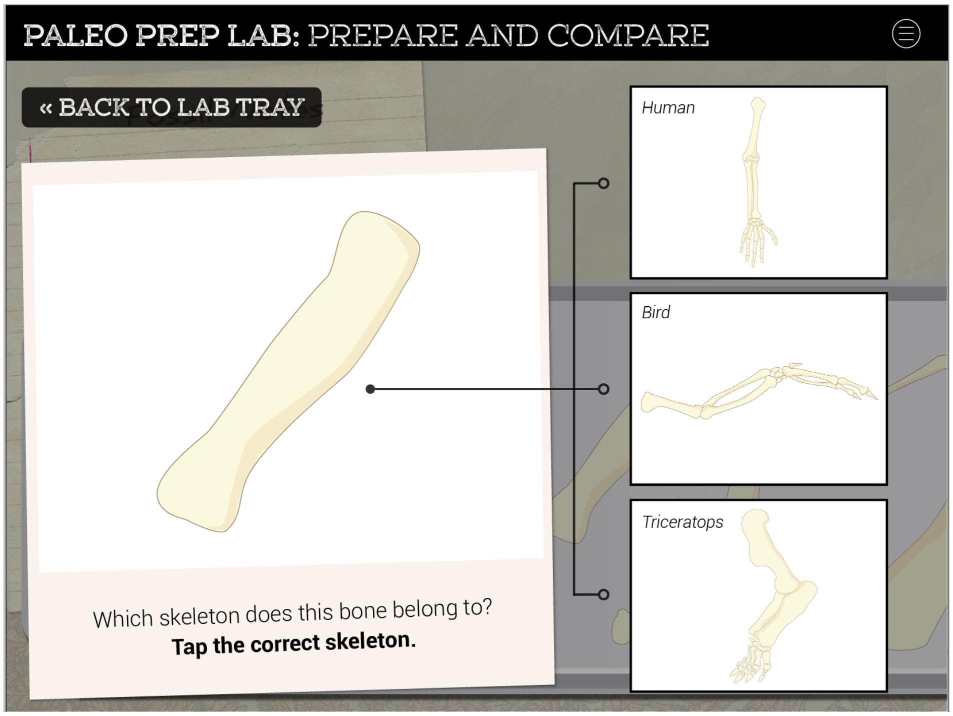


**Figure 133. The screen shows the enlarged bone and prompts users to tap the skeleton the bone belongs to (*Human, bird or Triceratops)*. If the selection is incorrect, the screen moves to Figure 134. If the selection is correct, the screen moves to Figure 135.**

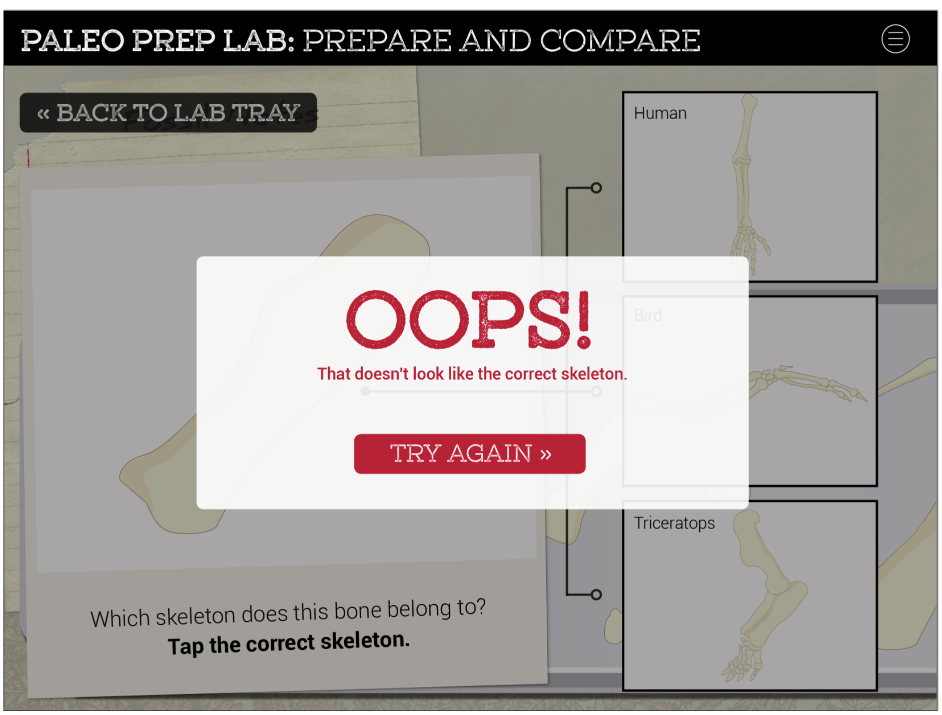


**Figure 134. Users will be alerted that their selection was wrong. The "Try Again" button will take them back to Figure 133. From there, when they make the correct selection, the screen moves to Figure 135.**

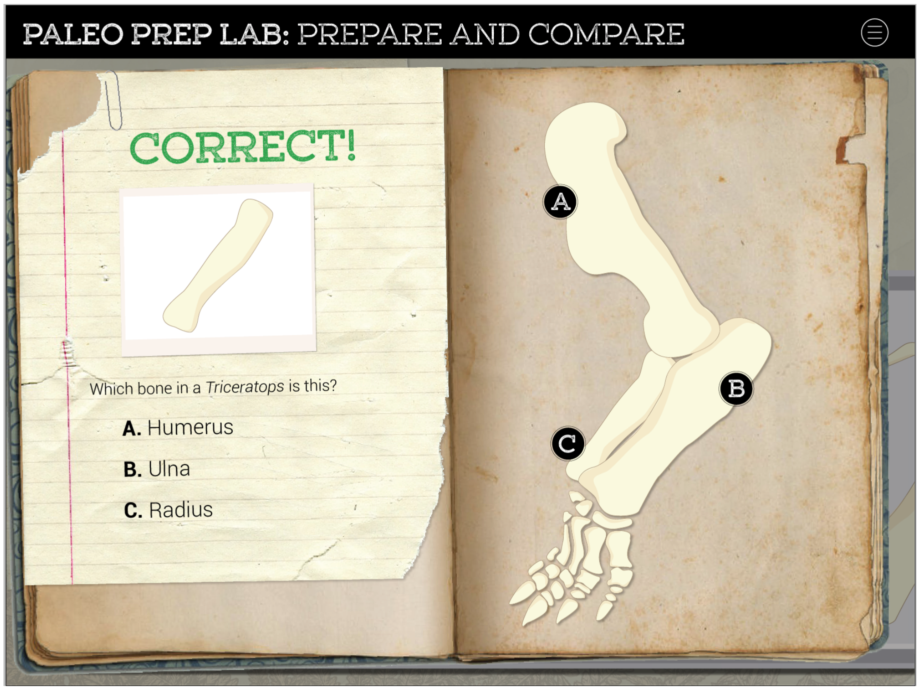


**Figure 135. The screen shows the skeleton it belongs to but will then prompt users to identify which arm bone it is (*humerus, ulna or radius*). If the selection is incorrect, the screen moves to Figure 136. If the selection is correct, the screen moves to Figure 137.**

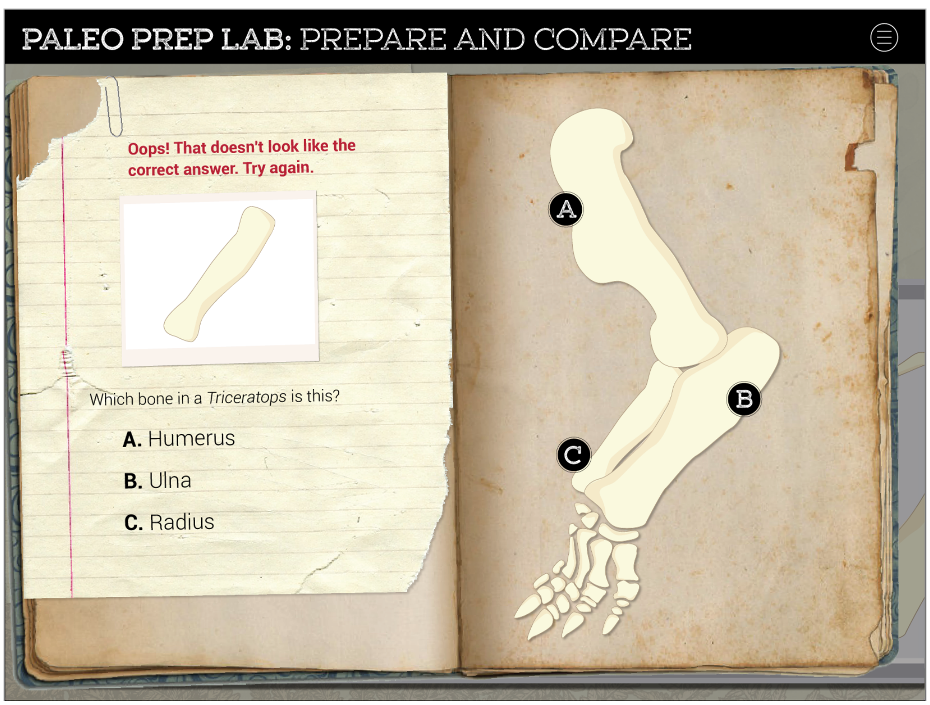


**Figure 136. Once the correct answer is selected, the screen moves to Figure 137.**

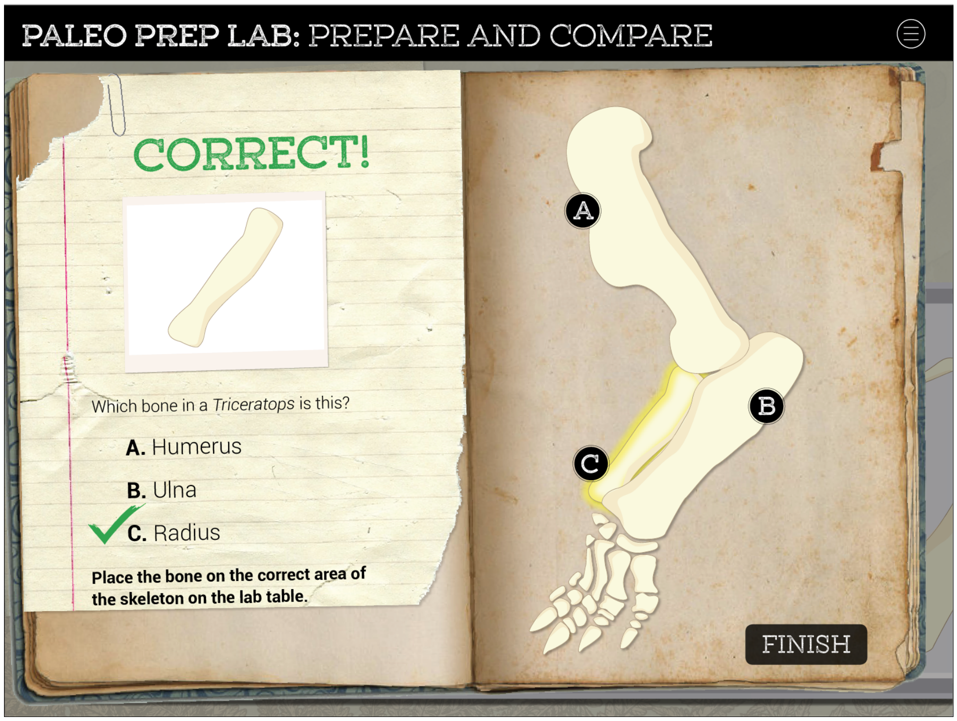


**Figure 137. The correct fossil is highlighted on the skeleton along with positive feedback and directions to place the physical fossil on the correct area of the skeleton outline on the lab table. The "Finish" button moves the screen to an overview of the activity (Figure 138).**

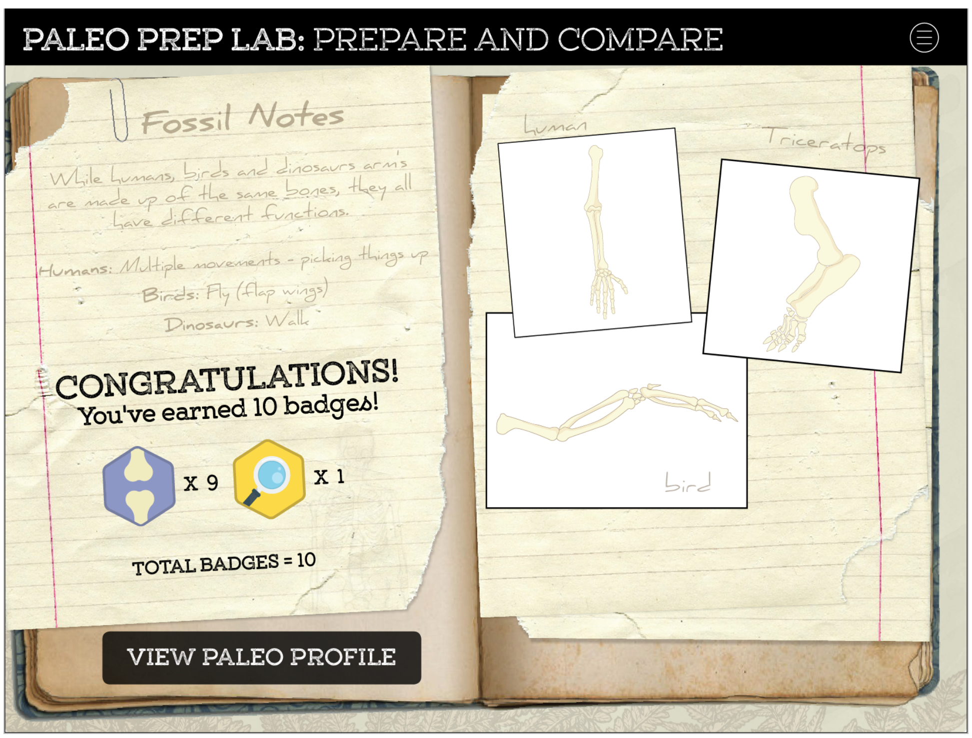


**Figure 138. The overview of the activity shows how many of each badge was earned and the total number of badges earned. By tapping "View Paleo Profile," the screen moves to Figure 139.**


**Figure 139. The user's Paleo Profile shows their new paleo status and an overview of the badges earned. At this time, the participant has completed the entire experience. By tapping "Finish," the screen moves to the participant's Paleontology Award (Figure 140).**


**Figure 140. The Paleontology Award displays that the user has become an expert paleontologist for the day. It is awarded by the *Dinosphere* exhibit at the Children's Museum of Indianapolis. The "Print" button sends the award to be printed and picked up at the exit of the exhibit.**

This experience was designed to create a more engaging digital experience, to generate more of a connection between physical and digital exhibit spaces, and enhance the overall user experience of the *Dinosphere* exhibit at the Children's Museum of Indianapolis. In addition, this experience was also designed to create a guided play environment, allowing children to explore independently in a structured learning environment, rather than a free play environment that the existing *Dinosphere* exhibit already provides. Subsequently, a study that compared the usability and user experience of the existing *Dinosphere* exhibit to this new interactive experience was conducted by another master's degree student in Ball State's Center for Emerging Media Design and Development and reported in her thesis, "*Dinosphere*: A Day in the Life - Usability and User Experience Research for Meaningful Play" (Kitchel, forthcoming). Results from this study are summarized in the following chapter.

## CHAPTER FOUR: DISCUSSION

This project explored the combination of physical and digital spaces in a museum environment. After thorough research focused on the museum experience and museum visitors, learning in museums, and cross-platform spaces in museums, an interactive experience was developed using an iterative, user-centered design process. The Children's Museum of Indianapolis agreed to collaborate on this project when the idea was proposed following a visitor observation of the *Dinosphere* exhibit done in Spring 2016. The observational research demonstrated that physical spaces in the *Dinosphere* exhibit were more popular, receiving more attention and engagement than the digital spaces. Several more observations were conducted in the *Dinosphere* exhibit along with the *Dinosaur Expedition* exhibit at the Chicago Children's Museum. A focus group held with five to 12 year olds offered a better understanding of what children enjoy in museum experiences and helped determine the direction of the experience. Semi-structured interviews with paleontology professors from the University of Cincinnati guided development of activities for the experience.

The interactive experience is an app - "*Dinosphere:* A Day in the Life" - that features three digital activities that work in collaboration with five physical spaces in the *Dinosphere* exhibit at the Children's Museum of Indianapolis. Within this experience, visitors act as a paleontologists for the duration of their visits in the exhibit, with each user receiving a lab coat, a name tag, and an iPad to use as a field notebook. Upon completing the activities, visitors earn paleo badges which developed their paleo status within the app. Badge categories are *fossil*, *dig*, and *curiosity*. The goal of the experience is to complete all three activities, earn a total of 38 badges, and become an "Expert Paleontologist." When complete, visitors receive a printed certificate to take home as a souvenir. While the current *Dinosphere* exhibit is meant to foster free play, the goal of this interactive experience is to foster guided play, allowing children to independently explore a structured learning environment. The structure of the activities in the experience allows visitors to roleplay and explore while they also take away valuable information about dinosaurs.

Research proposes that not all museum exhibits operate as simply and efficiently as exhibit designers wish they would. Because the aforementioned ethnographic research proposed that the *Dinosphere's* physical spaces attracted less attention than digital spaces, this interactive experience was designed to engage visitors in both the physical and digital areas of the *Dinosphere* exhibit simultaneously while they independently role played in a structured learning environment. This experience also assists in expanding the current audience of the *Dinosphere* exhibit of three to five year olds to an additional target audience of eight to 12 year olds.

A study that compared the existing *Dinosphere* experience to this new one was conducted by another master's degree student in Ball State's Center for Emerging Media Design and Development and reported in her thesis, "*Dinosphere*: A Day in the Life - Usability and User Experience Research for Meaningful Play" (Kitchel, forthcoming). Preliminary usability testing of the current *Dinosphere* exhibit took place in Fall 2016. First, participants were asked to play freely in each area of the *Dinosphere* exhibit for approximately 10 minutes. Exhibit areas of the *Dinosphere* include: 1) *The*

*Dig Site*, 2) *T. rex Attack,* 3) *Paleo Prep Lab,* 4) *Leonardo the Mummified Dinosaur,* and 5) *Eggs, Nest and Babies.* After each of the play sessions, participants completed a questionnaire, a System Usability Scale, and a group interview about the experience conducted by the researcher.

The five-item questionnaire focused on enjoyment, fun, confusion, difficulty, and the likelihood a participant would be to return to the exhibit station in the future. The System Usability Scale (SUS) (Brooke, 1996) was administered to determine how easy or difficult it was for participants to interact with the *Dinosphere* exhibit areas. Semi-structured interviews were conducted to elicit feedback about the overall user experience. The questions encouraged the children to reflect on their favorite and least favorite part of each exhibit area, whether each station was easy or difficult to engage with, and if they learned anything from each area. Overall, participants found the five exhibit areas in *Dinosphere* to be generally enjoyable and fun, and reported a relatively high likelihood that they would return and play again in the future. Likewise, participants were rarely confused about the nature of each exhibit area and had little difficulty determining what to do. This shows that the existing *Dinosphere* exhibit is relatively user-friendly. Similarly, a majority of the exhibit areas scored relatively high on the System Usability Scale. The same procedure was followed for the second round of testing. However, this time participants engaged with the new "*Dinosphere:* A Day in the Life" interactive experience. Feedback about the experience was exceptionally positive. Participants explained that the new interactive experience was more enjoyable than the original Dinosphere exhibit by itself. Some of them even noticed parts of the exhibit they wouldn't normally have looked at without the interactive experience. They made it somewhat of a competition, which was a positive both physically and mentally. Confusion level was low, however the experience did cause participants to somewhat pick at their brains, asking a couple questions throughout the testing. Finally, a majority of participants expressed their excitement to return to the museum and participate in the interactive experience again.

The digital age of today's society often convinces one that adding technology to substitute something is a simple solution. However, it is much more complex than that. Digital museum experiences tend to take visitor's attention away from the physical exhibit environment. Ethnographic research specific to this project showed that the digital components of the current *Dinosphere* exhibit were typically engaged with less and for a shorter amount of time. The new interactive experience "*Dinosphere:* A Day in the Life" contributes to a resolution, allowing museum visitors to use a digital platform to engage specifically with the physical aspects of the museum exhibit. The layering of information and activities offers a semi-structured environment fostering guided play, which enhances the overall experience of the *Dinosphere* exhibit. With appropriate understanding of the context, content, and audience, this technique can be replicated across almost any museum exhibit, with the understanding that technology is not substituting for anything, but enhancing the overall environment.

Although The Children's Museum of Indianapolis may never have the resources or desire to implement "*Dinosphere:* A Day in the Life," three external evaluations conducted by a paleontology professor, a user experience designer and former *Dinosphere* volunteer, and a member of the museum's staff were largely positive. According to Susan Foutz, Director of Research and Evaluation at the museum, "…this project takes the approach of layering information and activities onto an existing experience in a way that both respects the original experience and enhances it." She also believes that the aesthetic of the project creates an authentic atmosphere within the Dinosphere exhibit. Relating to Foutz's comments on the aesthetic, former *Dinosphere* volunteer, Megan McNames, expressed "the visual design is exceptional, and the look and feel of "*Dinosphere:* A Day in the Life" is on par with some of the most well-designed museum apps that I've seen."  Finally, paleontologist Josh Miller reassures the credibility of the project content in his review by stating, "the three components of this project are wonderful choices to engage anyone in what it is to be a paleontologist." He believes this project has a strong potential to provide an interesting, intuitive, and positive learning experience for museum visitors.

## OUTSIDE EVALUATIONS

EXTERNAL EVALUATION
BY
JOSHUA MILLER

### The Evaluator

I am a paleontologist and conservation paleobiologist who works across the globe to better understand the history of life. Using a multidisciplinary framework that incorporates statistical modeling, multivariate analysis, GIS, and fieldwork, my research focuses on modern, historical, and fossil bone accumulations to test fundamental paleoecological, taphonomic, and biological theory across decadal- to millennial- timescales. I also use the ecological data available in bone accumulations to establish baselines of historical ecological variability to inform management and conservation planning (Arctic National Wildlife Refuge, Yellowstone National Park, Amboseli National Park, Kenya). By using modern and even Pleistocene bone accumulations, the composition and structure of modern animal communities, as well as species interactions, biogeography, landscape-use, and migratory patterns can be placed in quantitative historical (102 to 104 years) perspectives. Further, these baselines can be incorporated into models built to explore how future changes in climate and other anthropogenic perturbations may impact biological systems at the population- to ecosystem-levels.

**Relationship to the Student and Subject Matter**

I am a fierce advocate for creative and effective public outreach. I have been very pleased to advise Kelly Hopkins as she develops e-learning curricula to enhance experiences at the Children's Museum of Indianapolis. As museums and universities continue to explore virtual spaces for enhancing traditional education and outreach, there is a growing need for high quality electronic frameworks and content. The basic structure of the modules Kelly has been developing could be of value for many museum settings and to enhance a variety of university courses.

**Evaluation of the Project**

*Project Design and Concept*

Overall, I think this project has strong potential to provide an interesting, intuitive, and positive experiential (and potentially immersive) learning experience for visitors (children or adult!) of the museum. I wish I had access to the in-museum components of the project to get a more complete idea of the project. But even without that information,  I can see this is (and could be even further developed) into a solid contribution to the museum.

*Research and Writing*

The writing in the first section is generally well done and the most engaging (though I would encourage some editing concerning the descriptions of the paleoecology). The writing in other section is not as engaging -- though that may also be because more of those sections rely on physical components at the museum (and there is surely some balance between storytelling and providing a short set-up so kids can get on with the project). Though particularly with part 3 (comparative anatomy) I think adding a more comprehensive set-up slide would help engage kids in the material prior to the current intro slide. Something with visual appeal (e.g., showing the wing of a bird, a person reaching up to pick an apple, and a Triceratops standing there. Perhaps with the bones of the 3 arms showing through the "skins" (like an x-ray) of all three, highlighting the focus of the project). There are several places where the writing could be edited for scientific content. Overall, minor tweaks are all that would be required.

*Graphic Design and/or Project Presentation*

I think the graphic design and interface are very strong. The only component that could benefit from greater consideration are the badges. It was not entirely clear to me how these were earned, what they mean, etc. Thus, it was not clear what NOT earning all the badges would imply. Perhaps an introductory slide explaining these would be helpful. And, perhaps, with each correct answer a badge could be awarded at the time?

Overall, to get a fuller understanding of the overall experience, I would love to see this in action at the museum (too bad that was not possible). I will also say that  the third component is something I could use in my "Dinosaurs" class. Well done! I think that section would benefit from providing a little more context regarding how each bone is used differently among the different species/groups (non-avian dinosaurs, birds, humans/primates).

*Storytelling*

The three components of this project are wonderful choices to engage anyone in what it is to be a paleontologist. It starts with big picture (paleoecological reconstructions), which is a nice way to engage the learner and think about big picture analysis and some of the overall goals of paleontological study. The second gets learners into thinking about the incompleteness of the fossil record (though I believe that is never explicitly discussed/mentioned) and provides some introduction to anatomy. The third section, comparative anatomy (and evolution), is hugely important and gets down to the core of a lot of vertebrate paleontological work -- studying how different species modify the core body plan shared by all vertebrates to do amazingly varied things. I would love to have seen greater exploration into what the differences among the bones were and how that leads to different uses of the “arms”. I would strongly encourage (happy to help!) additional development in a future iteration of the project.

In terms of storytelling, while I appreciate the components of the project on their own, I think more could be done to weave them together. Currently, the three sections are treated mostly as discrete. I think there are ways to meld them together into a single story arch that would help learners understand what they are doing within the context of each item. And, indeed, how the different sections can build upon each other. That said,  I think the project provides an overall engaging experience.

EXTERNAL EVALUATION
BY
MEGAN MCNAMES

**The Evaluator**

**Relationship to the Student and Subject Matter**

Megan McNames served as the Assistant Director of Ball State University's Digital Publishing Studio (DPS) in 2015-2016 while the student was employed by the studio as a student designer. In addition to volunteering in the *Dinosphere* at the Children's Museum of Indianapolis from 2012 to 2015, McNames also worked with DPS students (not including the student whose project is under review) in 2015 on an interactive digital marketing tablet app for the museum's digital marketing department. In her role as Director of User Experience at Emplify in Fishers, Ind., McNames oversees the design and usability testing of a multi-platform B2B people analytics product. From 2009 to 2016 she taught Digital Media Design at Ball State University.

**Evaluation of the Project**

*Project Design and Concept*

The stated problem addressed by the project appears two-fold: Children visiting the *Dinosphere* do not take advantage of the digital learning opportunities available in the exhibit and getting visitors to integrate such technologies into their visits is very hard to do in general. The stated design challenge is "How might digital and physical spaces work together in museum exhibits to create a successful learning environment?"

To explore that problem space and propose a potential solution, the student developed a very appropriate research methodology consisting of ethnographic research of the target audience's behavior in the exhibit space, a participatory game design session with the target audience and requirements gathering from museum stakeholders and subject matter experts.

The success of that research is evident in several ways – the "*Dinosphere:* A Day in the Life" app content clearly aligns with the museum's stated *Dinosphere* learning outcomes, uses content from the exhibit itself, uses a visual style congruent with that of the exhibit and is factually accurate and age-appropriate. This helps the app to align with and integrate into the exhibit in terms of content, audience and so on.

Additionally, the app successfully leverages digital capabilities to prove out the need for its own existence above and beyond the physical content of the exhibit. While reviewing the app I consistently asked myself whether the activities it was offering were superior to an analog experience, say, just handing each visitor a clipboard with a paper worksheet on it. There's no doubt that the interactive capabilities have been leveraged very well here so that the interactions support the learning objectives, are fun and personalized and offer an experience far beyond what is available in the physical space.

At the same time, I am not sure that "*Dinosphere:* A Day in the Life" goes far enough in creating strong "holding" and "teaching" power in the physical space due to some small but important details. The "Scene Selection" game is the most promising in regards to "holding" and "teaching" power in that its content clearly matches the physical content of the exhibit and its instructions suggest exploring both simultaneously. While playing the "Scene Selection" game, one can imagine carrying it on an iPad from one staged fossil scene in the exhibit to the next to take the quizzes and understand the scene's narrative. In fact, I have to admit that prior to playing the "Scene Selection" game I had not noticed just how much the three paintings at the beginning of the *Dinosphere* exhibit are *such exact replicas* of the staged fossil scenes in the exhibit, despite all the time I have spent in the exhibit. In terms of integrating the digital and physical spaces, I think there is some room for improvement in the language of "*Dinosphere:* A Day in the Life" as well as how some of the instructions are presented. At the macro level, I wasn't entirely clear from the written materials accompanying the project whether the two activities that were marked with locations (*The Dig Site and The Paleo Prep Lab*) actually needed to take place at those locations or if they had a physical component that I somehow misunderstood. The instructions in "Prepare and Compare" for example ask the user to "Remove each fossil from its field jacket," which does not appear to be a digital activity – so am I to assume there is a related physical activity in the museum? It is not clear from the instructions in the app.

There are several other instances of the instructions not quite capturing or supporting what the user is supposed to do in the physical space. For example, the instructions given after the user correctly identifies the scene described in the narrative ask him or her to “Find this scene in the exhibit and answer a few questions.” However, if the child is trying to find the staged fossil version of the scene, there’s some time during which his or her attention is leaving the digital learning tool in order to physically traverse the exhibit. Stronger prompting such as replacing the content-oriented label of the “Questions” button with the action-oriented label “I found the scene!” might offer more “holding” power and better connect the digital tool to the physical actions visitors are taking. Providing some feedback for the child in case he or she gets lost would further position the digital tool as an important component of navigating the physical space of the exhibit and not just a fun extra (as I played the game, I imagined myself in the museum. When prompted to “Find this scene in the exhibit” I imagined going to the painting of the scene, not the staged fossil version. The only feedback I received from the app that maybe I was in the wrong location was an image on the next screen – but nothing on the page told me I needed to be looking in real life at what was in the image).

All told, the student set out to create a digital experience that better integrated into the *Dinosphere*. She developed a very appropriate research protocol to seek clarity around the audience’s behaviors (ethnography), preferences (game design session) and abilities (expert interviews) and stakeholder needs (brainstorming with museum staff). This approach I think is novel and unique and of interest for many museums, where a long legacy of curatorship has typically locked visitors out of the design process.

*Research and Writing*

What the student learned by conducting a Literature Review, developing and conducting project-based research and going through the design process is emergent rather than explicit – I wish it were more explicit. The protocols provided in the appendices and the descriptions of the project-based research provided in the body of the paper lead me to believe that the student developed a strong approach to understanding the problem and potential solutions from the perspective of the audience and stakeholders. The inclusion of a game design session with the target audience is very clever, as is the focus of the game design session on any exhibit the children in it liked, lest the participating children not be interested in or know anything about *Dinosphere*. At the same time, results of these research endeavors were not presented or summarized much in the body of the paper or in the appendices. This is a shame, because I think the approach is one of the more novel things about the project considering how much the legacy of curatorship has affected how many museums approach the design of exhibits and associated technologies.

I would have liked to see more of the theory from the Literature Review – guided learning, the HCCI framework – discussed at the end of the paper or used as justification for why decisions were made throughout the design process. Or as an alternative, more focus given in the Literature Review to how the Design Thinking process used on this project represents a new way of thinking for museum technologists.

*Graphic Design and/or Project Presentation*

I've discussed a few usability shortfalls in the initial review of the overall project and its goals (namely some limitations to how the language adequately connects the app content to the physical space) and there do exist a couple more (for example, I wish each activity explained ahead of time what badges would be earned by completing them and why those specific badges would be earned – or some other solution to the problem of the badging system not being legible). Finally, there were a few opportunities for more engaging visuals that show instead of tell (showing the parts of the body *T. rex* and Gorgosaurus share, rather than listing them as text, for example).

Beyond those criticisms, the design is incredibly easy to use (I am so curious about the associated usability report!) and makes expert use of design and user experience principles. The visual design is exceptional, and the look and feel of "*Dinosphere:* A Day in the Life" is on par with some of the most well-designed museum apps that I've seen.

*Storytelling*

The positioning of the app as field notes used by a visitor who is stepping into his or her role as a budding paleontologist is a very strong use of storytelling and as the student notes in her paper, incredibly appropriate for an age group that enjoys and learns from role playing and make believe. The use of activities that support that story and in fact actually make the story real (the visitors *really are* getting closer than they were before to being dinosaur experts) is one of the strongest aspects of this project!

As part of the storytelling around being a paleontologist for a day, I would have liked to know a little more about that important process of giving the digital tool over to the visitor. In the paper, the process is described briefly: "The visitor acts as a paleontologist for the duration of their visit in the exhibit, receiving a lab coat, a name tag and an iPad as their field notebook." How the iPad is positioned as a field notebook in that exchange between museum staff and child is really important, and the instructions that capture this important hand-off don't convey the excitement of the event or the usefulness of the iPad as a tool in the endeavor. There's a disconnect between the story conveyed in that handoff – welcome to the museum, you are now a budding paleontologist, here's your coat and field notes – and how the app handles it (with a four-point list of instructions rather than scenes in a story).

EXTERNAL EVALUATION
BY
SUSAN FOUTZ

**The Evaluator**

Susan Foutz, Director of Research and Evaluation at The Children's Museum of Indianapolis, leads the study design and implementation of the museum's evaluations for exhibitions and programs. Before joining the museum in 2014, Susan was an evaluation consultant at the nonprofit Institute for Learning Innovation for 9 years. In that capacity, she co-edited the books *In Principle, In Practice* and *Free-Choice Learning and the Environment.* Susan is a member of the American Evaluation Association and the Visitor Studies Association. She holds a MA in Museum Studies from the University of Nebraska-Lincoln and a BA in Sociology/Anthropology from Ohio Wesleyan University.

**Relationship to the Student and Subject Matter**

Susan met Kelly Hopkins in 2016 when she spoke to the Ball State University EMDD cohort at the request of Jennifer Palilonis. She also served as the primary liaison between Kelly and the museum for her master's project; in this role she scheduled in-person meetings with staff, gave Kelly a tour of Dinosphere, and provided Kelly with planning documents related to the creation of Dinosphere. She also served as a reviewer for the project.

**Evaluation of the Project**

*Project Design and Concept*

The Dinosphere exhibit is one of the museum's most visited but repeat visitors and first time visitors alike. For those who have been here before, or for those who want a more game-like or quest-like experience, this project is a great addition.

This project takes the approach of layering information and activities onto an existing experience in a way that both respects the original experience and enhances it. Digital add-ons have the tendency to take visitors' attention away from the objects and the carefully constructed exhibit environment--or at least the is the fear/worse case scenario for the museum's exhibition team. This project, however, leads the visitor through the exhibit experience, prompting them to look closely at the fossils and the labels. In that way it is a great complement to the existing experience.

The digital project also leads the visitor through the multi-part exhibit, encouraging them to explore the dioramas, *Paleo Prep Lab*, and *The Dig Site*. This is great for us because one of the metrics we often look at is "thoroughness of use" --1) where all sections of the exhibit visited at equal rates versus some areas being dead zones where visitors don't go and 2) do visitors engage deeply versus a surface level engagement. Anything that can encourage thoroughness of use is a plus. Additionally, the ability to chose which part of the exhibit to visit/explore first and pair that with the related digital activity is great. Since we don't have linear exhibits (go here, then go here, or the exhibit doesn't make sense), digital experiences can't be too linear either.

*Research and Writing*

It seems Kelly has taken a master's level course in Museum Studies based on her lit review. She clearly took seriously the research into the context of museums in general and the prevailing philosophies specifically. I would have liked to see a wider range of sources sited in addition to Falk, Dierking and their colleagues but agree that theirs is some of the most accessible and often cited works on museum learning by museum professionals and non-museum professional. I also appreciated the focus on play in the lit review as it is a vital part of how the target age group learns and how many children's museums position themselves.

One of the exciting things about this app is how well-paired it is with the exhibit's goals: we want children and families to understand what we know and how we know all this information about dinosaurs. So it is about the process of and products from paleontology. I think this project was superb at recognizing these aspects within the exhibit itself and pairing that with the interviews with paleontologists from outside of the museum. The multi-layered approach to understanding the context, the problem, and the underlying educational needs of the audience really make this an outstanding project.

*Graphic Design and/or Project Presentation*

The graphic design and overall presentation is very professional. This is of the quality (or even better than the quality) of many digital experiences I've seen in museums.

The project matches the feeling and approach that we've used in the *Dinosphere* exhibit itself. It has a similar aesthetic and color palette as the exhibit.  So it feels very intentional and seamless even though it was created just recently and the exhibit is 10+ years old. The format of a field notebook once you are in the app collecting evidence is also a great fit. We want visitors to feel like what they're doing is authentic or at least as close as possible to what a real paleontologist would do. The idea of the notebook matches with this--just like you'd take your notebook out to look for fossils and record what you see, you do that here in the exhibit.

Another aspect that I really appreciated was the imagery from the exhibit--so you see the scene of the dioramas in the different formats we used (painted recreation and fossil installation), and additional images that clearly relate to the content but that don't appear in the exhibit (like the picture of Bucky Derflinger with the fossil "Bucky").

*Storytelling*

The storytelling approach in the app portion of the project was effective at meeting the goals as laid out in the project paper. The app effectively acts as a bridge between the digital space and the physical space of the exhibition, encouraging visitors to engage more deeply with the dinosaurs on display. The current digital experiences in the gallery (which are nearly 16 years old!) do not effectively bridge this gap, and certainly not to the degree that this project does. Interestingly, this gap was also recognized by a graduate student intern studying human-computer interactions at IUPUI in the summer of 2016. Her project focused on ways to bridge this gap using touchscreens in the gallery. The app project, because of its mobile nature, allowing you to see the exhibit from different vantage points as you take the content/activities with you, is likely a more productive approach.

The app also is effective at meeting the project goal of providing a guided experience for youth ages 8 to 12. It makes effective use of the exhibit space and by using a narrative approach has an appeal that is different, but complementary to the free-choice experience of the exhibit. I can imaging that it effectively would engage youth in the target age range.

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**Appendix A**

***Dinosphere***
**Big Idea:** You can study fossils to search for clues about fossils.
**Secondary Messages:**
- How did dinosaurs interact with one another? Fossils tell us some dinosaurs lived in family groups.
- What was it like to be a top predator? Fossils tell us life could be dangerous and short at the top of the food chain.
- How did dinosaurs thrive, then become extinct? Fossil clues tell us dinosaurs thrived for millions of years before extinction.
- How do we know what we know about dinosaurs? Paleontologists find, prepare and study fossils for clues about ancient life.

**Tertiary Messages:**
- Some dinosaurs helped each other.
- Some dinosaurs lived in herds and migrated to find food.
- Dinosaurs laid eggs of different shapes and sizes.
- Some dinosaurs laid their eggs and left them. Others took care of their hatchlings.
- Many kinds of dinosaurs thrived in the Cretaceous world.
- We're not sure how dinosaurs became extinct.
- Today's birds are descendants of the dinosaurs.
- Dinosaurs fought for food, mates and territory.

***T. rex Attack***
**Big Idea:** You can study fossils to search for clues about dinosaurs
**Secondary Messages:**
- Fossils tell us life could be dangerous and short at the top of the food chain.
- Fossils tell us some dinosaurs lived in family groups.

**Tertiary Messages:**
- Dinosaurs fought for food, mates and territory.
- Disease and wounds were constant threats.
- Some dinosaurs helped each other.

***The Watering Hole***
**Big Idea:** You can study fossils to search for clues about dinosaurs
**Secondary Messages:**
- Fossils tell us some dinosaurs lived in family groups.
- Fossil clues tell us dinosaurs thrived for millions of years before extinction.

**Tertiary Messages:**
- Some dinosaurs lived in herds and migrated to find food.
- Some dinosaurs helped each other.
- Some dinosaurs took care of their hatchlings.

***Scavenger vs Predator***
**Big Idea:** You can study fossils to search for clues about dinosaurs
**Secondary Messages:**
- Fossils tell us life could be dangerous and short at the top of the food chain.
- How do we know what we know about dinosaurs? Paleontologists find, prepare and study fossils for clues about ancient life.

**Tertiary Messages:**

- Dinosaurs fought for food, mates and territory.
- Disease and wounds were constant threats.
- We prepare dinosaur fossils and study them.
- Some dinosaurs lived in herds and migrated to find food.
- Some dinosaurs took care of their hatchlings.
- Today's birds are descendants of the dinosaurs.

***Dig Site***

**Big Idea:** You can study fossils to search for clues about dinosaurs
**Secondary Messages:**

- Paleontologists find, prepare and study fossils for clues about ancient life.

**Tertiary Messages:**

- We dig up dinosaur fossils and study them

***Leonardo the Mummified Dinosaur***

**Big Idea:** We study Leonardo the Mummified Dinosaur because his body contains more clues about dinosaur life than any other fossil in the world.
**Secondary Messages:**

- Leonardo is a unique specimen because so much of his skin, muscles, tendons and stomach contents were preserved through mummification and fossilization.
- Leonardo's body teaches us about dinosaur appearance, anatomy, diet, skin texture and habitat.
- There are so many unanswered questions about dinosaur life. For instance, what color was Leonardo? What did his organs look like? Maybe you'll help us find answers as we continue to study Leonardo in the coming years.

***Paleo Prep Lab***

**Big Idea:** You can study fossils to search for clues about dinosaurs
**Secondary Messages:**

- How do we know what we know about dinosaurs? Paleontologists find, prepare and study fossils for clues about ancient life.

**Tertiary Messages:**

- Dinosaur art illustrates what we think we know.
- What we think we know has changed over time.
- We dig up dinosaur fossils and study them.

***Eggs, Nest and Babies***

**Big Idea:** You can study fossils to search for clues about dinosaurs
**Secondary Messages:**

- How did dinosaurs interact with one another? Fossils tell us some dinosaurs lived in family groups.

**Tertiary Messages:**

- Dinosaurs laid eggs of different shapes and sizes.
- Some dinosaurs laid their eggs and left them. Others took care of their hatchlings.
- Today's bird are descendants of dinosaurs.

**Appendix B**

Hi, my name is Kelly Hopkins and I am a graduate student at Ball State University. I am in my second year in the Center for Emerging Media Design and Development.

Last year, our Emerging Media and Design Thinking class required us to do ethnographic research here at the museum. My research group decided to observe the *Dinosphere* exhibit. We focused on observing different ways museum visitors interact with physical and digital spaces within the exhibit. That preliminary research led me to this project idea.

**GOAL**

The goal of this project is to create an interactive experience combining digital and physical spaces within the *Dinosphere* exhibit at the Children's Museum of Indianapolis that enhances the overall experience of the exhibit.

**HOW WE BRAINSTORM**

Today our brainstorming session will consist of 4 prompts. In each phase, I will ask you to write down ideas that answer a specific prompt. Write each idea on a separate sticky note. Answers should be concise - three to four words at most. You will have 2 minutes to write down as many ideas that you can think of. This method will help produce a bunch of ideas without getting overwhelmed with details.

When time is up, we'll have a guided discussion. We will group all of the answers from your sticky notes into categories. By the end of the discussion, we'll have a wall of sticky notes that show all of the connections between your ideas. We will walk away from each session with insights that will be used to create final design solutions.

**CONSTRAINTS**

I have already determined one constraint that must be used in this project. That is...

> *There must be a combination of physical and digital components.*

This first exercise is going to help determine other constraints for the project. So, for this prompt I would like each of you to write down the worst children's museum experiences you've seen. This can be ANY museum experience. You have two minutes to write down as many answers as possible. We will discuss answers after.

> **PROMPT 1:** *The worst children's museum experience is...*

The second exercise is going to help determine key requirements for the project. You have 2 minutes to write down answers describing the best children's museum experience. Again, this is not specific to any one museum. This can be any museum experience that you think is great.

> **PROMPT 2:** *The best children's museum experience is…*

The next exercise is going to help determine any ideas that might be mimicked and used in this project. Again, this can be ANY experience at all. You have two minutes, write down as many ideas as possible.

**PROMPT 3:** *If you could steal an experience (museum or not) what would it be?*

**AUDIENCE MATRIX**
Show the matrix.

**CLIENT**
The client for this project is The Children's Museum of Indianapolis because you guys have agreed to work in collaboration with this project, allowing me to do research and test in the *Dinosphere* exhibit. Thank you so much for agreeing to work with me for the project. I understand that this idea might not be pushed through to full development and that is OK, but your feedback is still very valuable.

**TARGET AUDIENCE**
The target audience for this project is children's museum visitors between the ages of eight and 12.

**INDIRECT CLIENT**
The indirect client for this project is the museum Board of Trustees. Because might there be a possibility that this is something you guys want to implement into the *Dinosphere* exhibit in the future, the Board of Trustees would eventually have to be involved.

**INDIRECT AUDIENCE**
The indirect audience for this project is families and other museum staff.

Are we missing anybody on the matrix that needs to/should be involved in the project? If so, who are they and why should they be involved?

**TARGET AUDIENCE**
Now, for the target audience of this project. Based on information from the Family Learning Data from 2008 for *Dinosphere,* the largest audience is 3-5 year olds. I want to expand the audience by targeting this interactive experience to 8-12 year olds. Ideally, any museum visitor will be able to go through the *Dinosphere* exhibit any way they choose, which could be exactly the same way as it is now, but the goal is to offer this interactive experience to enhance the exhibit for those that choose to engage with it.

So, I've come up with three different child personas for the target audience of this project. These personas were not created based off of any specific audience research but were solely created to show the different types of museum visitors that could be in the target audience.

First we have Timmy. Timmy is an 11 year old 5th grader. He enjoys making movie trailers and he loves Star Wars and Pokemon. (Explain Timmy)

Next we have Kiyah. She is an 8 year old 3rd grader. Her hobbies include reading, playing with dogs and baking. She loves animals and science as well. (Explain Kiyah)

And then we have Corey. He is a 9 year old 4th grader. His hobbies include playing soccer and the violin, along with handheld video games. He really enjoys music. (Explain Corey)

Each of these children are a potential audience member for this interactive experience for the *Dinosphere* exhibit. Is there any audience I didn't reach?

*IF THEY DENY 8-12 YEAR OLD AUDIENCE:*
The *Dinosphere* exhibit already does a great job reaching 3-5 year olds. The reason I chose this 8-12 year old audience is because I do not want to do something the museum already does so well. Also, according to the *Dinosphere* Family Learning document, children eight years and above comprehend the concept of fossils and refer to what they are seeing and learning in the exhibit, which helps support the achieving the Big Idea of the exhibit.

*IF THEY STILL DENY:*
Project must be designed around younger audience.

**MEASURING SUCCESS**
The first thing I'd like to ask is… What has made past/present exhibits successful? What defined success in these exhibits? Is it analytics? Is it a specific type of engagement?

The next and last prompt is probably the most important. This is going to help me understand what exactly I need to build my experience around.

So more specific to my project, how might we measure overall success?

**FOLLOW UP**
How might be measure success for exhibits/experiences that combine physical and digital spaces?

These will all be things that I know must be taken into consideration when creating this experience. I will take all of the ideas generated from this session and revise them before making any final decisions.

**Appendix C**

First off I want to thank you all for coming here today. I really appreciate your parents allowing you to participate in this activity and I think we're going to have a lot of fun today.

My name is Kelly Hopkins. I am trying to learn about how children best interact with the different areas in a museum because I am creating a new experience for the *Dinosphere* exhibit at the Children's Museum of Indianapolis.

Show of hands, how many of you have been to a children's museum? Have any of you been to the Children's Museum of Indianapolis? Did you visit the *Dinosphere* exhibit?

Your parents have already said it's OK for you to be in my study. If you don't want to be in the study, no one will be mad at you. If you want to be in the study now and change your mind later, that's OK. You can stop at any time.

Today you're going to have to answer a few questions and then participate in a fun activity. I will use the information you give me to create an experience that will allow children who visit the *Dinosphere* exhibit at the museum to be a paleontologist for a day. They will get to see what it's like to be a real paleontologist by digging for bones, learning about the different kind of bones and much more!

Other people will not know if you're in my study. I will put things I learn about you together with other things I learn about other children, so no one can tell what things come from you. When I tell other people about my research, I will not use your name, so no one can tell who I am talking about. I will be audio recording the things we talk about today so I can remember all the awesome, valuable information you tell me.

I am going to pass out an assent form that I would like for you to sign if you agree to be in this study. Your parents signed one as well, giving their approval. I will also give you a copy of the form in case you have questions later on.

Are there any questions right now? First I am going to start with some questions that we will have a discussion about. Please remember, all of your ideas and answers are valuable and helpful to me. I want to get to know what children your age like about museums so that my project can be as fun as possible and all children will want to use it. Don't be afraid to share every idea that comes to mind.

1. What is the first thing you want to do when you get to a museum?
2. What makes you want to do that first?
3. What are the things you like about that specific thing?
4. How would you show your friends at the museum this thing?
    a. How would you convince them to be interested in looking at it?

Okay… now we're going to do an activity. I've created a game design station for each of you that includes a variety of different tools for you to create your own game. I'm going to give you 20 minutes to design a game around your favorite museum exhibit. This can be ANY exhibit you've ever been to. Be very specific and include any ideas you can think of.

**SHOW AND TELL**

*Have each child show what they designed and talk about it more in depth*
*Have each of the other children tell them ONE thing they like about what they presented*

*Why do they like it?*

One more discussion: Now, if you could make a game about dinosaurs, what would it look it? What would it consist of? What would be the goal of the game? How would you get your friends to play that game? What are the ways you would get them to want to play it?

**Appendix D**

As I stated in the email, I am a graduate student at Ball State University in the Center for Emerging Media Design and Development. I am currently working on a project in partnership with the Children's Museum of Indianapolis, specifically working in the *Dinosphere* exhibit.

Design thinking is one of the pillars of The Center. I am using design thinking as part of my project process. This means I am gathering information from a large group of people, which then allows me to generate direct solutions related to my specific project.

Based on preliminary ethnographic research, I came up with the idea to create an interactive experience that puts visitors in the shoes of a paleontologist as they go through the *Dinosphere* exhibit. This role-playing idea is also backed by academic research along with design thinking research I've done.

I am now interested in talking to paleontologists to help determine the activities I am going to develop for the interactive experience. The experience will put museum visitors in the shoes of a paleontologist. They will be role-playing throughout the *Dinosphere* exhibit. They will be able to visit each physical element of the museum where there will then be a digital component along with it. Each digital component will essentially be an activity in relation to the physical element of the exhibit.

My target audience is 8-12 year olds because the museum already reaches the younger audience very well, especially in the *Dinosphere* exhibit. Therefore I want to expand the audience of the exhibit, along with enhancing the overall experience of it.

- Are you familiar with the *Dinosphere* exhibit at the Children's Museum of Indianapolis?
  - Have you heard of it? Been there once.
  - Have you visited it? Number of years ago.
- *Give brief description of the exhibit what it includes*
  - Transports visitors to the land of the dinosaurs
  - See full-size dinosaur skeletons
  - Dig for dinosaur bones
  - One of the largest displays of juvenile dinosaur fossils in the world
  - Authentic *T. Rex* bone to touch
  - Live presentations
  - Prep lab
- What is your FAVORITE part about studying paleontology?